

GLOBAL
EDITION



Introductory and Intermediate Algebra

FIFTH EDITION

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ALWAYS LEARNING

PEARSON

INTRODUCTORY AND INTERMEDIATE ALGEBRA

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GLOBAL EDITION

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Objective 4.3d Collect the like terms of a polynomial.	
Example Collect like terms: $4x^3 - 2x^2 + 5 + 3x^2 - 12.$ $4x^3 - 2x^2 + 5 + 3x^2 - 12$ $= 4x^3 + (-2 + 3)x^2 + (5 - 12)$ $= 4x^3 + x^2 - 7$	Practice Exercise 7. Collect like terms: $5x^4 - 6x^2 - 3x^4 + 2x^2 - 3.$
Objective 4.4a Add polynomials.	
Example Add: $(4x^3 + x^2 - 8) + (2x^3 - 5x + 1).$ $(4x^3 + x^2 - 8) + (2x^3 - 5x + 1)$ $= (4 + 2)x^3 + x^2 - 5x + (-8 + 1)$ $= 6x^3 + x^2 - 5x - 7$	Practice Exercise 8. Add: $(3x^4 - 5x^2 - 4) + (x^3 + 3x^2 + 6).$
Objective 4.5d Multiply any two polynomials.	
Example Multiply: $(z^2 - 2z + 3)(z - 1).$ We use columns. First, we multiply the top row by -1 and then by z , placing like terms of the product in the same column. Finally, we collect like terms. $\begin{array}{r} z^2 - 2z + 3 \\ z - 1 \\ \hline -z^2 + 2z - 3 \\ z^3 - 2z^2 + 3z \\ \hline z^3 - 3z^2 + 5z - 3 \end{array}$	Practice Exercise 9. Multiply: $(x^4 - 3x^2 + 2)(x^2 - 3).$
Objective 4.6a Multiply two binomials mentally using the FOIL method.	
Example Multiply: $(3x + 5)(x - 1).$ F O I L $(3x + 5)(x - 1) = 3x \cdot x + 3x \cdot (-1) + 5 \cdot x + 5 \cdot (-1)$ $= 3x^2 - 3x + 5x - 5$ $= 3x^2 + 2x - 5$	Practice Exercise 10. Multiply: $(y + 4)(2y + 3).$
Objective 4.6b Multiply the sum and the difference of the same two terms mentally.	
Example Multiply: $(3y + 2)(3y - 2).$ $(3y + 2)(3y - 2) = (3y)^2 - 2^2$ $= 9y^2 - 4$	Practice Exercise 11. Multiply: $(x + 5)(x - 5).$
Objective 4.6c Square a binomial mentally.	
Example Multiply: $(2x - 3)^2.$ $(2x - 3)^2 = (2x)^2 - 2 \cdot 2x \cdot 3 + 3^2$ $= 4x^2 - 12x + 9$	Practice Exercise 12. Multiply: $(3w + 4)^2.$

Objective 4.7e Subtract polynomials.	
Example Subtract: $(m^4n + 2m^3n^2 - m^2n^3) - (3m^4n + 2m^3n^2 - 4m^2n^2).$ $(m^4n + 2m^3n^2 - m^2n^3) - (3m^4n + 2m^3n^2 - 4m^2n^2)$ $= m^4n + 2m^3n^2 - m^2n^3 - 3m^4n - 2m^3n^2 + 4m^2n^2$ $= -2m^4n - m^2n^3 + 4m^2n^2$	Practice Exercise 13. Subtract: $(a^3b^2 - 5a^2b + 2ab) - (3a^3b^2 - ab^2 + 4ab).$
Objective 4.8a Divide a polynomial by a monomial.	
Example Divide: $(6x^3 - 8x^2 + 15x) \div (3x)$. $\frac{6x^3 - 8x^2 + 15x}{3x} = \frac{6x^3}{3x} - \frac{8x^2}{3x} + \frac{15x}{3x}$ $= \frac{6}{3}x^{3-1} - \frac{8}{3}x^{2-1} + \frac{15}{3}x^{1-1}$ $= 2x^2 - \frac{8}{3}x + 5$	Practice Exercise 14. Divide: $(5y^2 - 20y + 8) \div 5$.
Objective 4.8b Divide a polynomial by a divisor that is a binomial.	
Example Divide $x^2 - 3x + 7$ by $x + 1$. $\begin{array}{r} x - 4 \\ x + 1 \overline{) x^2 - 3x + 7} \\ \underline{x^2 + x} \\ -4x + 7 \\ \underline{-4x - 4} \\ 11 \end{array}$ The answer is $x - 4 + \frac{11}{x + 1}$.	Practice Exercise 15. Divide: $(x^2 - 4x + 3) \div (x + 5)$.
Review Exercises	
Multiply and simplify. [4.1d, f] 1. $7^2 \cdot 7^{-4}$ 2. $y^7 \cdot y^3 \cdot y$ 3. $(2x)^4 \cdot (2x)^{11}$ 4. $t^8 \cdot t^0$ Divide and simplify. [4.1e, f] 5. $\frac{4^5}{4^2}$ 6. $\frac{a^5}{a^8}$ 7. $\frac{(7x)^4}{(7x)^4}$ Simplify. 8. $(3t^4)^2$ [4.2a, b] 9. $(2x^3)^2(-3x)^2$ [4.1d], [4.2a, b]	
10. $\left(\frac{2x}{y}\right)^{-3}$ [4.2b] 11. Express using a negative exponent: $\frac{1}{t^5}$. [4.1f] 12. Express using a positive exponent: y^{-4}. [4.1f] 13. Convert to scientific notation: 0.00000283. [4.2c] 14. Convert to decimal notation: 8.3×10^6. [4.2c] Multiply or divide and write scientific notation for the result. [4.2d] 15. $(3.8 \times 10^4)(5.5 \times 10^{-1})$ 16. $\frac{1.75 \times 10^9}{2.5 \times 10^4}$	

17. **Pizza Consumption.** Each man, woman, and child in the United States eats an average of 46 slices of pizza per year. The U.S. population is projected to be about 340 million in 2020. At this rate, how many slices of pizza would be consumed in 2020? Express the answer in scientific notation. [4.2e]

Sources: Packaged Facts; U.S. Census Bureau

18. Evaluate the polynomial $x^3 - x^2 + 3x - 6$ when $x = -1$. [4.3a]
19. Identify the terms of the polynomial $-4y^5 + 7y^2 - 3y - 2$. [4.3b]
20. Identify the missing terms in $x^3 + x$. [4.3f]
21. Identify the degree of each term and the degree of the polynomial $4x^3 + 6x^2 - 5x + \frac{5}{3}$. [4.3c]

Classify the polynomial as a monomial, a binomial, a trinomial, or none of these. [4.3b]

22. $4x^3 - 1$

23. $4 - 9t^3 - 7t^4 + 10t^2$

24. $7y^2$

Collect like terms and then arrange in descending order. [4.3e]

25. $3x^2 - 2x + 3 - 5x^2 - 1 - x$

26. $-x + \frac{1}{2} + 14x^4 - 7x^2 - 1 - 4x^4$

Add. [4.4a]

27. $(3x^4 - x^3 + x - 4) + (x^5 + 7x^3 - 3x^2 - 5) + (-5x^4 + 6x^2 - x)$

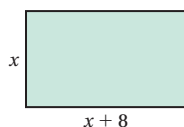
28. $(3x^5 - 4x^4 + x^3 - 3) + (2x^4 - 6x^3 + 2x^2 + x) + (-4x^5 - 4x^2) + (-5x^4 + 2x^3 + 5x + 6)$

Subtract. [4.4c]

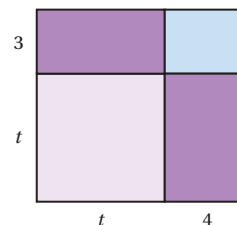
29. $(5x^2 - 4x + 1) - (3x^2 + 1)$

30. $(3x^5 - 4x^4 + 3x^2 + 3) - (2x^5 - 4x^4 + 3x^3 + 4x^2 - 5)$

31. Find a polynomial for the perimeter and for the area. [4.4d], [4.5b]



32. Find two algebraic expressions for the area of this figure. First, regard the figure as one large rectangle, and then regard the figure as a sum of four smaller rectangles. [4.4d]



Multiply.

33. $(x + \frac{2}{3})(x + \frac{1}{2})$ [4.6a] 34. $(5x + 2)^2$ [4.6c]

35. $(4x^2 - 5x + 1)(3x - 2)$ [4.5d] 36. $(3x^2 + 4)(3x^2 - 4)$ [4.6b]

37. $5x^4(3x^3 - 8x^2 + 10x + 2)$ [4.5b]

38. $(x + 4)(x - 7)$ [4.6a]

39. $(3y^2 - 2y)^2$ [4.6c] 40. $(2t^2 + 3)(t^2 - 7)$ [4.6a]

41. Evaluate the polynomial

$$3 - 4xy + x^2 + y^2 - 5xy^3 + x^6$$

when $x = -1$ and $y = 2$. [4.7a]

42. Identify the coefficient and the degree of each term of the polynomial

$$x^5y - 7xy + 9x^2 - 8.$$

Then find the degree of the polynomial. [4.7b]

Collect like terms. [4.7c]

43. $y + w - 2y + 8w - 5$

44. $m^6 - 2m^2n + m^2n^2 + n^2m - 6m^3 + m^2n^2 + 7n^2m$

45. Add: [4.7d]

$$(5x^2 - 7xy + y^2) + (-6x^2 - 3xy - y^2) + (x^2 + xy - 2y^2).$$

46. Subtract: [4.7e]

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

Multiply. [4.7f]

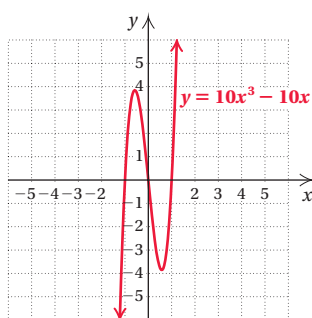
47. $(p - q)(p^2 + pq + q^2)$ 48. $(3a^4 - \frac{1}{3}b^3)^2$

Divide.

49. $(9x^3 - 4x^2 + 6x) \div 3x$ [4.8a]

50. $(6x^3 - 5x^2 - 13x + 13) \div (2x + 3)$ [4.8b]

51. The graph of the polynomial equation $y = 10x^3 - 10x$ is shown below. Use *only* the graph to estimate the value of the polynomial when $x = -1$, $x = -0.5$, $x = 0.5$, and $x = 1$. [4.3a]



52. Subtract: $(2x^2 - 3x + 4) - (x^2 + 2x)$. [4.4c]

- A. $x^2 - 3x - 2$ B. $x^2 - 5x + 4$
C. $x^2 - x + 4$ D. $3x^2 - x + 4$

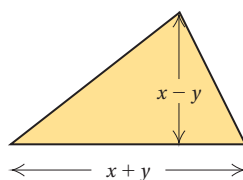
53. Multiply: $(x - 3)^2$. [4.6c]

- A. $x^2 - 9$ B. $x^2 + 9$
C. $x^2 - 6x + 9$ D. $x^2 - 6x - 9$

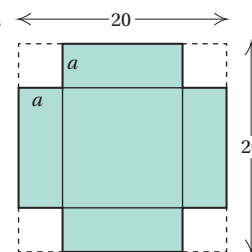
Synthesis

Find a polynomial for each shaded area. [4.4d], [4.6b]

54.



55.



56. Collect like terms: [4.1d], [4.2a], [4.3d]

$$-3x^5 \cdot 3x^3 - x^6(2x)^2 + (3x^4)^2 + (2x^2)^4 - 40x^2(x^3)^2.$$

57. Solve: [2.3b], [4.6a]

$$(x - 7)(x + 10) = (x - 4)(x - 6).$$

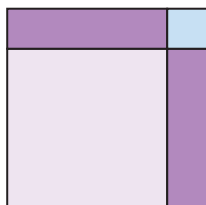
58. The product of two polynomials is $x^4 - 1$. One of the polynomials is $x - 1$. Find the other. [4.8b]

59. A rectangular garden is twice as long as it is wide and is surrounded by a sidewalk that is 4 ft wide. The area of the sidewalk is 1024 ft². Find the dimensions of the garden. [2.3b], [4.4d], [4.5a], [4.6a]



Understanding Through Discussion and Writing

- Explain why the expression 578.6×10^{-7} is not written in scientific notation. [4.2c]
- Explain why an understanding of the rules for order of operations is essential when evaluating polynomials. [4.3a]
- How can the following figure be used to show that $(x + 3)^2 \neq x^2 + 9$? [4.5c]



4. On an assignment, Emma *incorrectly* writes

$$\frac{12x^3 - 6x}{3x} = 4x^2 - 6x.$$

What mistake do you think she is making and how might you convince her that a mistake has been made? [4.8a]

- Can the sum of two trinomials in several variables be a trinomial in one variable? Why or why not? [4.7d]
- Is it possible for a polynomial in four variables to have a degree less than 4? Why or why not? [4.7b]

Multiply and simplify.

1. $6^{-2} \cdot 6^{-3}$

2. $x^6 \cdot x^2 \cdot x$

3. $(4a)^3 \cdot (4a)^8$

Divide and simplify.

4. $\frac{3^5}{3^2}$

5. $\frac{x^3}{x^8}$

6. $\frac{(2x)^5}{(2x)^5}$

Simplify.

7. $(x^3)^2$

8. $(-3y^2)^3$

9. $(2a^3b)^4$

10. $\left(\frac{ab}{c}\right)^3$

11. $(3x^2)^3(-2x^5)^3$

12. $3(x^2)^3(-2x^5)^3$

13. $2x^2(-3x^2)^4$

14. $(2x)^2(-3x^2)^4$

15. Express using a positive exponent: 5^{-3} .

16. Express using a negative exponent: $\frac{1}{y^8}$.

17. Convert to scientific notation: 3,900,000,000.

18. Convert to decimal notation: 5×10^{-8} .

Multiply or divide and write scientific notation for the answer.

19. $\frac{5.6 \times 10^6}{3.2 \times 10^{-11}}$

20. $(2.4 \times 10^5)(5.4 \times 10^{16})$

21. **Earth vs. Saturn.** The mass of Earth is about 6×10^{21} metric tons. The mass of Saturn is about 5.7×10^{23} metric tons. About how many times the mass of Earth is the mass of Saturn? Express the answer in scientific notation.

22. Evaluate the polynomial $x^5 + 5x - 1$ when $x = -2$.

23. Identify the coefficient of each term of the polynomial $\frac{1}{3}x^5 - x + 7$.

24. Identify the degree of each term and the degree of the polynomial $2x^3 - 4 + 5x + 3x^6$.

25. Classify the polynomial $7 - x$ as a monomial, a binomial, a trinomial, or none of these.

Collect like terms.

26. $4a^2 - 6 + a^2$

27. $y^2 - 3y - y + \frac{3}{4}y^2$

28. Collect like terms and then arrange in descending order:

$$3 - x^2 + 2x^3 + 5x^2 - 6x - 2x + x^5.$$

Add.

29. $(3x^5 + 5x^3 - 5x^2 - 3) + (x^5 + x^4 - 3x^3 - 3x^2 + 2x - 4)$

30. $\left(x^4 + \frac{2}{3}x + 5\right) + \left(4x^4 + 5x^2 + \frac{1}{3}x\right)$

Subtract.

31. $(2x^4 + x^3 - 8x^2 - 6x - 3) - (6x^4 - 8x^2 + 2x)$

32. $(x^3 - 0.4x^2 - 12) - (x^5 + 0.3x^3 + 0.4x^2 + 9)$

Multiply.

33. $-3x^2(4x^2 - 3x - 5)$

34. $\left(x - \frac{1}{3}\right)^2$

35. $(3x + 10)(3x - 10)$

36. $(3b + 5)(b - 3)$

37. $(x^6 - 4)(x^8 + 4)$

38. $(8 - y)(6 + 5y)$

39. $(2x + 1)(3x^2 - 5x - 3)$

40. $(5t + 2)^2$

41. Collect like terms:

$x^3y - y^3 + xy^3 + 8 - 6x^3y - x^2y^2 + 11.$

42. Subtract:

$(8a^2b^2 - ab + b^3) - (-6ab^2 - 7ab - ab^3 + 5b^3).$

43. Multiply: $(3x^5 - 4y^5)(3x^5 + 4y^5).$

Divide.

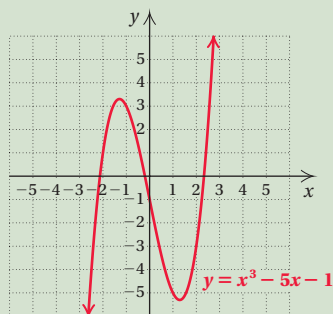
44. $(12x^4 + 9x^3 - 15x^2) \div (3x^2)$

45. $(6x^3 - 8x^2 - 14x + 13) \div (3x + 2)$

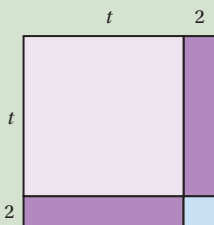
46. The graph of the polynomial equation

$y = x^3 - 5x - 1$

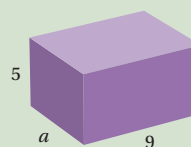
is shown at right. Use *only* the graph to estimate the value of the polynomial when $x = -1$, $x = -0.5$, $x = 0.5$, $x = 1$, and $x = 1.1$.



47. Find two algebraic expressions for the area of this figure. First, regard the figure as one large rectangle, and then regard the figure as a sum of four smaller rectangles.



48. Which of the following is a polynomial for the surface area of this right rectangular solid?



A. $28a$

B. $28a + 90$

C. $14a + 45$

D. $45a$

Synthesis

49. The height of a box is 1 less than its length, and the length is 2 more than its width. Find the volume in terms of the length.

50. Solve: $(x - 5)(x + 5) = (x + 6)^2.$