27. $8i - (2 - 8i)$

28. $3 - (4 - 5i)$

29. $5i \cdot 8i$

30. $(-3i)(2i)$

31. $\sqrt{-50} \cdot \sqrt{-2}$

32. $\sqrt{-12} \cdot \sqrt{-27}$

33. $3(2 + 5i) - 2(3 - 2i)$

34. $3i(2 + 5i) + 2i(3 - 4i)$

35. $(4 + 2i)(3 - 4i)$

36. $(6 + 5i)(2 - 5i)$

37. $(-3 - 4i)(2 + 7i)$

38. $(-5 - i)(2 + 3i)$

39. $(4 - 5i)(4 + 5i)$

40. $(3 + 7i)(3 - 7i)$

41. $\dfrac{6}{i}$

42. $\dfrac{-8}{2i}$

43. $\dfrac{6 + 3i}{i}$

44. $\dfrac{4 - 8i}{4i}$

45. $\dfrac{1}{7 + 2i}$

46. $\dfrac{5}{3 + 4i}$

47. $\dfrac{2i}{1 + i}$

48. $\dfrac{5i}{2 - 3i}$

49. $\dfrac{5 - i}{4 + 5i}$

50. $\dfrac{4 + i}{3 + 5i}$

51. $\dfrac{3 + 2i}{3 - 2i}$

52. $\dfrac{8 - i}{2 + 3i}$

53. $\dfrac{-7 + 26i}{4 + 3i}$

54. $\dfrac{-4 - 39i}{5 - 2i}$

55. $(3 - 5i)^2$

56. $(2 + 4i)^2$

57. $(1 + 2i)^2$

58. $(2 - i)^2$

In Exercises 59 to 66, evaluate.

59. i^{15}

60. i^{66}

61. $-i^{40}$

62. $-i^{51}$

63. $\dfrac{1}{i^{25}}$

64. $\dfrac{1}{i^{83}}$

65. i^{-34}

66. i^{-52}

In Exercises 67 to 70, evaluate $\dfrac{-b + \sqrt{b^2 - 4ac}}{2a}$ for the given values of a, b, and c. Write your answer as a complex number in standard form.

67. $a = 2, b = 4, c = 4$

68. $a = 4, b = -4, c = 2$

69. $a = 3, b = -3, c = 3$

70. $a = 2, b = 6, c = 6$

Enrichment Exercises

In Exercises 71 and 72, expand the power of the complex number.

71. $(1 - 3i)^3$

72. $(2 + i)^4$

73. Show that $\sqrt{i} = \dfrac{1}{\sqrt{2}} + \dfrac{i}{\sqrt{2}}$.

74. Show that $\sqrt{-i} = \dfrac{1}{\sqrt{2}} - \dfrac{i}{\sqrt{2}}$.

Exploring Concepts with Technology

Can You Trust Your Calculator?

You may think that your calculator always produces correct results in a *predictable* manner. However, the following experiment may change your opinion.

First note that the algebraic expression

$$p + 3p(1 - p)$$

is equal to the expression

$$4p - 3p^2$$

Use a graphing calculator to evaluate both expressions with $p = 0.05$. You should find that both expressions equal 0.1925. So far, we do not observe any unexpected results. Now replace p in each expression with the current value of that expression (0.1925 in this case). This is called *feedback* because we are feeding our output back into each expression as input. Each new evaluation is referred to as an *iteration*. This time, each expression takes on the value

(continued)

0.65883125. Still no surprises. Continue the feedback process. That is, replace p in each expression *with the current value* of that expression. Now each expression takes on the value 1.33314915207, as shown in the following table. The iterations were performed on a TI-85 calculator.

Iteration	$p + 3p(1 - p)$	$4p - 3p^2$
1	0.1925	0.1925
2	0.65883125	0.65883125
3	1.33314915207	1.33314915207

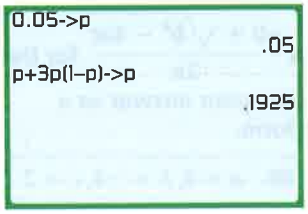
The following table shows that if we continue this feedback process on a calculator, the expressions $p + 3p(1 - p)$ and $4p - 3p^2$ will start to take on different values beginning with the fourth iteration. By the 37th iteration, the values do not even agree to two decimal places.

Iteration	$p + 3p(1 - p)$	$4p - 3p^2$
4	7.366232839E-4	7.366232838E-4
5	0.002944865294	0.002944865294
6	0.011753444481	0.0117534448
7	0.046599347553	0.046599347547
20	1.12135618652	1.12135608405
30	0.947163304835	0.947033128433
37	0.285727963839	0.300943417861

1. Use a calculator to find the first 20 iterations of $p + 3p(1 - p)$ and $4p - 3p^2$, with the initial value of $p = 0.5$.
2. Write a report on chaos and fractals. Include information on the "butterfly effect." An excellent source is *Chaos and Fractals, New Frontiers of Science* by Heinz-Otto Peitgen, Hartmut Jurgens, and Dietmar Saupe (New York: Springer-Verlag, 1992).
3. Equations of the form $p_{n+1} = p_n + rp_n(1 - p_n)$ are called *Verhulst population models.* Write a report on Verhulst population models.

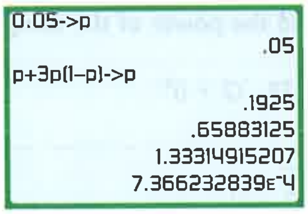
Integrating Technology

To perform the iterations at the right with a TI graphing calculator, first store 0.05 in p and then store $p + 3p(1 - p)$ in p, as shown below.



```
0.05->p
                        .05
p+3p(1-p)->p
                      .1925
```

Each time you press ENTER, the expression $p + 3p(1 - p)$ will be evaluated with p equal to the previous result.



```
0.05->p
                        .05
p+3p(1-p)->p
                      .1925
                  .65883125
              1.33314915207
             7.366232839E⁻4
```

CHAPTER P TEST PREP

The following test prep table summarizes essential concepts in this chapter. The references given in the right-hand column list Examples and Exercises that can be used to test your understanding of a concept.

P.1 The Real Number System

- The following sets of numbers are used extensively in algebra:

Natural numbers	{1, 2, 3, 4, . . . }
Whole numbers	{0, 1, 2, 3, 4, . . . }
Integers	{. . . , −3, −2, −1, 0, 1, 2, 3, . . . }
Rational numbers	$\left\{\frac{p}{q}, \text{ where } p \text{ and } q \text{ are integers and } q \neq 0\right\}$ {all terminating and repeating decimals}
Irrational numbers	{all nonterminating, nonrepeating decimals}
Real numbers	{all rational or irrational numbers}

See Example 1, page 3, and then try Exercises 1 and 2, page 70.

• Set-builder notation is a method of writing sets that has the form $\{\text{variable} \mid \text{condition on the variable}\}$.	See Example 2, page 4, and then try Exercise 5, page 70.
• The union of two sets A and B is the set of all elements that belong to either A or B. • The intersection of two sets A and B is the set of all elements that belong to both A and B.	See Example 3, page 5, and then try Exercises 7 and 8, page 70.
• Sets of real numbers can be written in interval notation. Pages 5–6 shows and the various forms of interval notation.	See Examples 4 and 5, pages 6 and 7, then try Exercises 9 and 12, page 70.
• The absolute value of a real number a is given by $\lvert a \rvert = \begin{cases} a & \text{if } a \geq 0 \\ -a & \text{if } a < 0 \end{cases}$	See Example 6, pages 7–8, and then try Exercises 14 and 17, page 70.
• The distance $d(a, b)$ between two points a and b on a real number line is given by $d(a, b) = \lvert a - b \rvert$.	See Example 7, page 8, and then try Exercise 20, page 70.
• If b is any real number and n is a natural number, then $b^n = \underbrace{b \cdot b \cdot b \cdot \cdots \cdot b}_{b \text{ is a factor } n \text{ times}}.$	See Example 8, page 9, and then try Exercise 22, page 70.
• The Order of Operations Agreement specifies the order in which operations must be performed. See pages 9–10.	See Example 9, page 10, and then try Exercise 23, page 70.
• To evaluate a variable expression, replace the variables with their given try values. Then use the Order of Operations Agreement to simplify the result.	See Example 10, page 11, and then try Exercise 26, page 70.
• The properties of real numbers are used to simplify variable expressions. See pages 11–12.	See Examples 11 and 12, pages 12 and 13, and then try Exercises 29 and 36, page 70.
• Four properties of equality are symmetric, reflexive, transitive, and substitution.	See Example 13, page 13, and then try Exercise 34, page 70.

P.2 Integer and Rational Number Exponents

• If $b \neq 0$, then $b^0 = 1$. • If $b \neq 0$ and n is a natural number, then $b^{-n} = \frac{1}{b^n}$ and $\frac{1}{b^{-n}} = b^n$. • If n is an even positive integer and $b \geq 0$, then $b^{1/n}$ is the nonnegative real number such that $(b^{1/n})^n = b$. • If n is an odd positive integer, then $b^{1/n}$ is the real number such that $(b^{1/n})^n = b$. • For all positive integers m and n such that m/n is in simplest form, and for all real numbers b for which $b^{1/n}$ is a real number, $b^{m/n} = (b^{1/n})^m = (b^m)^{1/n}$.	See Example 1, pages 17–18, and then try Exercises 38 and 39, page 71. See Example 4, page 22 and then try Exercise 48, page 71.
Properties of Rational Exponents If p, q, and r are rational numbers and a and b are positive real numbers, then Product $\quad b^p \cdot b^q = b^{p+q}$ Quotient $\quad \frac{b^p}{b^q} = b^{p-q}$	See Example 2, page 19, and then try Exercises 50 and 53, page 71. See Example 5, pages 22–23 and then try Exercises 55 and 57, page 71.

(continued)

Power $(b^p)^q = b^{pq}$ $(a^p b^q)^r = a^{pr} b^{qr}$

$$\left(\frac{a^p}{b^q}\right)^r = \frac{a^{pr}}{b^{qr}} \qquad b^{-p} = \frac{1}{b^p}$$

- A number written in scientific notation has the form $a \times 10^n$, where $1 \le a < 10$ and n is an integer.

See Example 3, page 20, and then try Exercise 41, page 71.

Properties of Radicals

If m and n are natural numbers, and a and b are positive real numbers, then

Product $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$

Quotient $\dfrac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\dfrac{a}{b}}$

Index $\sqrt[m]{\sqrt[n]{b}} = \sqrt[mn]{b}$

See Example 6, page 25, and then try Exercise 61, page 71.

- A radical expression is in simplest form if it meets the criteria listed on page 25.

See Example 7, page 26, and then try Exercise 63, page 71.
See Example 8, page 26, and then try Exercises 65 and 68, page 71.

- To rationalize the denominator of a fraction means to write the fraction as an equivalent fraction that does not involve any radicals in the denominator.

See Examples 9 and 10, pages 27 and 28, and then try Exercises 70 and 71, page 71.

P.3 Polynomials

- The standard form of a polynomial of degree n is an expression of the form

$$a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$$

where n is a natural number and $a_n \neq 0$. The leading coefficient is a_n, and a_0 is the constant term.

See Example 1, page 32, and then try Exercise 73, page 71.

- The properties of real numbers are used to perform operations on polynomials.

See Example 2, page 32, and then try Exercise 75, page 71.
See Example 3, page 33, and then try Exercise 78, page 71.
See Example 4, page 34, and then try Exercise 80, page 71.

- Special product formulas are as follows.

Special Form	Formula(s)
(Sum)(Difference)	$(x + y)(x - y) = x^2 - y^2$
$(\text{Binomial})^2$	$(x + y)^2 = x^2 + 2xy + y^2$ $(x - y)^2 = x^2 - 2xy + y^2$

See Example 5, page 34, and then try Exercises 81 and 82, page 71.

P.4 Factoring

- The greatest common factor (GCF) of a polynomial is the product of the GCF of the coefficients of the polynomial and the monomial of greatest degree that is a factor of each term of the polynomial.

See Example 1, pages 39–40 and then try Exercise 84, page 71.

<table>
<tr><td>

- Some trinomials of the form $ax^2 + bx + c$ can be factored over the integers as the product of two binomials.

</td><td>See Example 2, page 40, and then try Exercise 88, page 71.
See Example 3, page 41 and then try Exercise 90, page 71.</td></tr>
<tr><td>

- Some special factoring formulas are as follows.

<table>
<tr><th>Special Form</th><th>Formula(s)</th></tr>
<tr><td>Difference of squares</td><td>$x^2 - y^2 = (x + y)(x - y)$</td></tr>
<tr><td>Perfect-square trinomials</td><td>$x^2 + 2xy + y^2 = (x + y)^2$
$x^2 - 2xy + y^2 = (x - y)^2$</td></tr>
<tr><td>Sum of cubes</td><td>$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$</td></tr>
<tr><td>Difference of cubes</td><td>$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$</td></tr>
</table>

</td><td>See Example 5, page 43, and then try Exercise 93, page 71.
See Example 6, page 44, and then try Exercise 94, page 71.
See Example 7, page 45, and then try Exercise 98, page 71.</td></tr>
<tr><td>

- A polynomial that can be written as $au^2 + bu + c$ is said to be quadratic in form. A strategy that is similar to that of factoring a quadratic trinomial can be used to factor some of these polynomials.

</td><td>See Example 8, pages 45–46, and then try Exercise 96, page 71.</td></tr>
<tr><td>

- Factoring by grouping may be helpful for polynomials with four or more terms.

</td><td>See Example 9, page 46, and then try Exercise 99, page 71.</td></tr>
<tr><td>

- Use the general factoring strategy given on page 47 to factor a polynomial.

</td><td>See Example 10, page 47, and then try Exercise 102, page 71.</td></tr>
</table>

P.5 Rational Expressions

• A rational expression is a fraction in which the numerator and denominator are polynomials. A rational expression is in simplest form when 1 is the only common factor of the numerator and denominator.	See Example 1, page 50, and then try Exercise 103, page 72.
Operations on Rational Expressions	
• To multiply rational expressions, multiply numerators and multiply denominators.	See Example 2, page 51, and then try Exercise 105, page 72.
• To divide rational expressions, invert the divisor and then multiply the rational expressions.	See Example 3, pages 51–52, and then try Exercise 106, page 72.
• To add or subtract rational expressions, write each expression in terms of a common denominator. Then perform the indicated operation.	See Example 4, pages 52–53, and then try Exercises 107 and 108, page 72.
• A complex fraction is a fraction whose numerator or denominator contains one or more fractions. There are two basic methods for simplifying a complex fraction. *Method 1:* Multiply both the numerator and the denominator by the least common denominator of all fractions in the complex fraction. *Method 2:* Simplify the numerator to a single fraction and the denominator to a single fraction. Multiply the numerator by the reciprocal of the denominator.	See Example 6 pages 54–55, then try Exercises 109 and 110, page 72.

P.6 Complex Numbers

• The imaginary unit, designated by the letter i, is the number such that $i^2 = -1$. If a is a positive real number, then $\sqrt{-a} = i\sqrt{a}$. The number $i\sqrt{a}$ is called an imaginary number. A complex number is one of the form $a + bi$, where a and b are real numbers and i is the imaginary unit. The real part of the complex number is a; the imaginary part of the complex number is b.	See Example 1, page 60, and then try Exercise 111, page 72.

(continued)

Operations on Complex Numbers • To add or subtract two complex numbers, add or subtract the real parts and add or subtract the imaginary parts	See Example 2, page 61, and then try Exercises 113 and 114, page 72.
• To multiply two complex numbers, use the FOIL method (first, outer, inner, last) and the fact that $i^2 = -1$.	See Example 3, page 62, and then try Exercise 116, page 72.
• To divide two complex numbers, multiply the numerator and denominator by the conjugate of the denominator.	See Example 4, page 63, and then try Exercise 120, page 72.
Powers of i If n is a positive integer, then $i^n = i^r$, where r is the remainder when n is divided by 4.	See Example 5, page 64, and then try Exercise 118, page 72.

CHAPTER P REVIEW EXERCISES

In Exercises 1 to 4, classify each number as one or more of the following: integer, rational number, irrational number, real number, prime number, composite number.

1. 3 **2.** $\sqrt{7}$ **3.** $-\frac{1}{2}$ **4.** $0.\overline{5}$

In Exercises 5 and 6, list the four smallest elements of the set.

5. $\{y \mid y = x^2, x \in \text{integers}\}$

6. $\{y \mid y = 2x + 1, x \in \text{natural numbers}\}$

In Exercises 7 and 8, use $A = \{1, 5, 7\}$ and $B = \{2, 3, 5, 11\}$ to find the indicated intersection or union.

7. $A \cup B$ **8.** $A \cap B$

In Exercises 9 and 10, graph each interval and write the interval in set-builder notation.

9. $[-3, 2)$ **10.** $(-1, \infty)$

In Exercises 11 and 12, graph each set and write the set in interval notation.

11. $\{x \mid -4 < x \leq 2\}$ **12.** $\{x \mid x \leq -1\} \cup \{x \mid x > 3\}$

In Exercises 13 to 18, write each expression without absolute value symbols.

13. $|7|$ **14.** $|2 - \pi|$ **15.** $|4 - \pi|$ **16.** $|-11|$

17. $|x - 2| + |x + 1|, -1 < x < 2$

18. $|2x + 3| - |x - 4|, -3 \leq x \leq -2$

19. If -3 and 7 are the coordinates of two points on the real number line, find the distance between the two points.

20. If $a = 4$ and $b = -1$ are the coordinates of two points on the real number line, find $d(a, b)$.

In Exercises 21 to 24, evaluate the expression.

21. -4^4 **22.** $-4^2(-3)^2$

23. $-5 \cdot 3^2 + 4\{5 - 2[-6 - (-4)]\}$

24. $6 - 2\left[4 - \dfrac{(-5)^2 - 29}{-2^2}\right]$

In Exercises 25 and 26, evaluate the variable expressions for $x = -2$, $y = 3$, and $z = -5$.

25. $-3x^3 - 4xy - z^2$ **26.** $2x - 3y(4z - x^3)$

In Exercises 27 to 34, identify the real number property or property of equality that is illustrated.

27. $5(x + 3) = 5x + 15$

28. $a(3 + b) = a(b + 3)$

29. $(6c)d = 6(cd)$

30. $\sqrt{2} + 3$ is a real number.

31. $7 + 0 = 7$

32. $1x = x$

33. If $7 = x$, then $x = 7$.

34. If $3x + 4 = y$ and $y = 5z$, then $3x + 4 = 5z$.

In Exercises 35 and 36, simplify the variable expression.

35. $8 - 3(2x - 5)$

36. $5x - 3[7 - 2(6x - 7) - 3x]$

In Exercises 37 to 40, simplify the exponential expression.

37. -2^{-5}

38. $-\dfrac{1}{\pi^0}$

39. $\dfrac{2}{z^{-4}}$

40. $\dfrac{x^{-4}}{y^{-3}}$

In Exercises 41 and 42, write each number in scientific notation.

41. 620,000

42. 0.0000017

In Exercises 43 and 44, change each number from scientific notation to decimal form.

43. 3.5×10^4

44. 4.31×10^{-7}

In Exercises 45 to 48, evaluate each exponential expression.

45. $25^{1/2}$

46. $-27^{2/3}$

47. $36^{-1/2}$

48. $\dfrac{3}{81^{-1/4}}$

In Exercises 49 to 58, simplify the expression.

49. $(-4x^3y^2)(6x^4y^3)$

50. $\dfrac{12a^5b}{18a^3b^6}$

51. $(-3x^{-2}y^3)^{-3}$

52. $\left(\dfrac{2a^2b^{-4}}{6a^{-3}b^6}\right)^{-2}$

53. $(-4x^{-3}y^2)^{-2}(8x^{-2}y^{-3})^2$

54. $\dfrac{(-2x^4y^{-5})^{-3}}{(4x^{-3}y^4)^{-2}}$

55. $(x^{-1/2})(x^{3/4})$

56. $\dfrac{a^{2/3}b^{-3/4}}{a^{5/6}b^2}$

57. $\left(\dfrac{8x^{5/4}}{x^{1/2}}\right)^{2/3}$

58. $\left(\dfrac{x^2y}{x^{1/2}y^{-3}}\right)^{1/2}$

In Exercises 59 to 72, simplify each radical expression. Assume that the variables are positive real numbers.

59. $\sqrt{48a^2b^7}$

60. $\sqrt{12a^3b}$

61. $\sqrt[3]{-135x^2y^7}$

62. $\sqrt[3]{-250xy^6}$

63. $b\sqrt{8a^4b^3} + 2a\sqrt{18a^2b^5}$

64. $3x\sqrt[3]{16x^5y^{10}} - 4y^2\sqrt[3]{2x^8y^4}$

65. $(3 + 2\sqrt{5})(7 - 3\sqrt{5})$

66. $(5\sqrt{2} - 7)(3\sqrt{2} + 6)$

67. $(4 - 2\sqrt{7})^2$

68. $(2 - 3\sqrt{x})^2$

69. $\dfrac{6}{\sqrt{8}}$

70. $\dfrac{9}{\sqrt[3]{9x}}$

71. $\dfrac{3 + 2\sqrt{7}}{9 - 3\sqrt{7}}$

72. $\dfrac{5}{2\sqrt{x} - 3}$

73. Write the polynomial $4x - 7x^2 + 5 - x^3$ in standard form. Identify the degree, the leading coefficient, and the constant term.

74. Evaluate the polynomial $3x^3 - 4x^2 + 2x - 1$ when $x = -2$.

In Exercises 75 to 82, perform the indicated operation and express each result as a polynomial in standard form.

75. $(2a^2 + 3a - 7) + (-3a^2 - 5a + 6)$

76. $(5b^2 - 11) - (3b^2 - 8b - 3)$

77. $(3x - 2)(2x^2 + 4x - 9)$

78. $(4y - 5)(3y^3 - 2y^2 - 8)$

79. $(3x - 4)(x + 2)$

80. $(5x + 1)(2x - 7)$

81. $(2x + 5)^2$

82. $(4x - 5y)(4x + 5y)$

In Exercises 83 to 86, factor out the GCF.

83. $12x^3y^4 + 10x^2y^3 - 34xy^2$

84. $24a^4b^3 + 12a^3b^4 - 18a^2b^5$

85. $(2x + 7)(3x - y) - (3x + 2)(3x - y)$

86. $(5x + 2)(3a - 4) - (3a - 4)(2x - 6)$

In Exercises 87 to 102, factor the polynomial over the integers.

87. $x^2 + 7x - 18$

88. $x^2 - 2x - 15$

89. $2x^2 + 11x + 12$

90. $3x^2 - 4x - 15$

91. $6x^3y^2 - 12x^2y^2 - 144xy^2$

92. $-2a^4b^3 - 2a^3b^3 + 12a^2b^3$

93. $9x^2 - 100$

94. $25x^2 - 30xy + 9y^2$

95. $x^4 - 5x^2 - 6$

96. $x^4 + 2x^2 - 3$

97. $x^3 - 27$

98. $3x^3 + 192$

99. $4x^4 - x^2 - 4x^2y^2 + y^2$

100. $2a^3 + a^2b - 2ab^2 - b^3$

101. $24a^2b^2 - 14ab^3 - 90b^4$

102. $3x^5y^2 - 9x^3y^2 - 12xy^2$

In Exercises 103 and 104, simplify each rational expression.

103. $\dfrac{6x^2 - 19x + 10}{2x^2 + 3x - 20}$

104. $\dfrac{4x^3 - 25x}{8x^4 + 125x}$

In Exercises 105 to 108, perform the indicated operation and simplify, if possible.

105. $\dfrac{10x^2 + 13x - 3}{6x^2 - 13x - 5} \cdot \dfrac{6x^2 + 5x + 1}{10x^2 + 3x - 1}$

106. $\dfrac{15x^2 + 11x - 12}{25x^2 - 9} \div \dfrac{3x^2 + 13x + 12}{10x^2 + 11x + 3}$

107. $\dfrac{x}{x^2 - 9} + \dfrac{2x}{x^2 + x - 12}$

108. $\dfrac{3x}{x^2 + 7x + 12} - \dfrac{x}{2x^2 + 5x - 3}$

In Exercises 109 and 110, simplify each complex fraction.

109. $\dfrac{2 + \dfrac{1}{x - 5}}{3 - \dfrac{2}{x - 5}}$

110. $\dfrac{1}{2 + \dfrac{3}{1 + \dfrac{4}{x}}}$

In Exercises 111 and 112, write the complex number in standard form.

111. $5 + \sqrt{-64}$

112. $2 - \sqrt{-18}$

In Exercises 113 to 120, perform the indicated operation and write the answer in simplest form.

113. $(2 - 3i) + (4 + 2i)$

114. $(4 + 7i) - (6 - 3i)$

115. $2i(3 - 4i)$

116. $(4 - 3i)(2 + 7i)$

117. $(3 + i)^2$

118. i^{345}

119. $\dfrac{4 - 6i}{2i}$

120. $\dfrac{2 - 5i}{3 + 4i}$

CHAPTER P TEST

1. For real numbers a, b, and c, identify the property that is illustrated by $(a + b)c = ac + bc$.

2. Graph $\{x \mid -3 \le x < 4\}$ and write the set in interval notation.

3. Given $-1 < x < 4$, simplify $|x + 1| - |x - 5|$.

4. Simplify: $(-2x^0y^{-2})^2(-3x^2y^{-1})^{-2}$

5. Simplify: $\dfrac{(2a^{-1}bc^{-2})^2}{(3^{-1}b)(2^{-1}ac^{-2})^3}$

6. Write 0.00137 in scientific notation.

7. Simplify: $\dfrac{x^{1/3}y^{-3/4}}{x^{-1/2}y^{3/2}}$

8. Simplify: $3x\sqrt[3]{81xy^4} - 2y\sqrt[3]{3x^4y}$

9. Simplify: $(2\sqrt{3} - 4)(5\sqrt{3} + 2)$

10. Simplify: $(2 - \sqrt{x + 4})^2$

11. Simplify: $\dfrac{x}{\sqrt[4]{2x^3}}$

12. Simplify: $\dfrac{3}{2 - 3\sqrt{7}}$

13. Simplify: $\dfrac{2 + \sqrt{5}}{4 - 2\sqrt{5}}$

14. Subtract: $(3x^3 - 2x^2 - 5) - (2x^2 + 4x - 7)$

15. Multiply: $(3a + 7b)(2a - 9b)$

16. Multiply: $(2x + 5)(3x^2 - 6x - 2)$

17. Factor: $7x^2 + 34x - 5$

18. Factor: $3ax - 12bx - 2a + 8b$

19. Factor: $16x^4 - 2xy^3$

20. Factor: $x^4 - 15x^2 - 16$

21. Simplify: $\dfrac{x^2 - 2x - 15}{25 - x^2}$

22. Simplify: $\dfrac{x}{x^2 + x - 6} - \dfrac{2}{x^2 - 5x + 6}$

23. Multiply: $\dfrac{x^2 - 3x - 4}{x^2 + x - 20} \cdot \dfrac{x^2 + 3x - 10}{x^2 + 2x - 8}$

24. Simplify: $\dfrac{2x^2 + 3x - 2}{x^2 - 3x} \div \dfrac{2x^2 - 7x + 3}{x^3 - 3x^2}$

25. Simplify: $x - \dfrac{x}{x + \dfrac{1}{2}}$

26. Write $7 + \sqrt{-20}$ in standard form.

In Exercises 27 to 30, write the complex number in simplest form.

27. $(4 - 3i) - (2 - 5i)$

28. $(2 + 5i)(1 - 4i)$

29. $\dfrac{3 + 4i}{5 - i}$

30. i^{97}