Dear Students,

To prepare you for next year's Pre-Calculus class, the Math Department requires that you complete a summer review assignment. This review will refresh your skills and concepts necessary to meet the challenges and prepare you for the variety of new concepts encountered in the Pre-Calculus course.

Solve each problem, showing all your work. You are expected to spend a minimum of 4 hours on this assignment, but it may require more if you are not familiar with the material. ALL problems assigned below need to be solved, and all work must be shown neatly and stapled. The completed assignment is due on the first day of class. All problems in this review should be material you have already mastered in previous courses. If anything does not look familiar, please ensure you get the proper help during the summer. For a refresher on any of the assigned topics, please go to www.patrickjmt.com for review videos.

HERE IS THE ASSIGNMENT:

Do the following problems from the attached pages:

P.3 Exercises pg. 31-32 #1-3 all, 7-12 all, 17-147 every other odd (i.e. 17, 21, 25, …)
P.4 Exercises pg. 42-43 #9-79 every other odd
P Review Exercises pg. 68 #13-16 all, 33-45 odd

If you have any questions, you may reach out to the Math Department Chair, Mrs. Brand, at: cbrand@moreaucatholic.org

See you in August!

P.3 Exercises

See www.CalcChat.com for worked-out solutions to odd-numbered exercises.
For instructions on how to use a graphing utility, see Appendix A.

Vocabulary and Concept Check

In Exercises 1–4, fill in the blank(s).

1. For the polynomial $a_n x^n + a_{n-1}x^{n-1} + \cdots + a_1 x + a_0$, the degree is _____ and the leading coefficient is _____ .
2. A polynomial with one term is called a _____ .
3. The letters in "FOIL" stand for the following.
   F _____ O _____ I _____ L _____
4. When a polynomial cannot be factored using integer coefficients, it is called _____ .
5. When is a polynomial completely factored?
6. List four guidelines for factoring polynomials.

Procedures and Problem Solving

Identifying Polynomials **In Exercises 7–12, match the polynomial with its description. [The polynomials are labeled (a), (b), (c), (d), (e), and (f).]**

(a) $6x$ (b) $1 - 4x^3$
(c) $x^3 + 2x^2 - 4x + 1$ (d) 7
(e) $-3x^5 + 2x^3 + x$ (f) $\frac{3}{4}x^4 + x^2 + 14$

7. A polynomial of degree zero
8. A trinomial of degree five
9. A binomial with leading coefficient -4
10. A monomial of positive degree
11. A trinomial with leading coefficient $\frac{3}{4}$
12. A third-degree polynomial with leading coefficient 1

Writing a Polynomial **In Exercises 13–16, write a polynomial that fits the description. (There are many correct answers.)**

13. A third-degree polynomial with leading coefficient -2
14. A fifth-degree polynomial with leading coefficient 8
15. A fourth-degree polynomial with a negative leading coefficient
16. A third-degree trinomial with an even leading coefficient

Writing a Polynomial in Standard Form **In Exercises 17–22, write the polynomial in standard form. Then identify the degree and leading coefficient of the polynomial.**

17. $3x + 4x^2 + 2$ 18. $x^2 - 4 - 3x^4$
19. $-8 + x^7$ 20. $23 - x^3$
✓ 21. $1 - x + 6x^4 - 2x^5$ 22. $7 + 8x$

Classifying an Expression **In Exercises 23–26, determine whether the expression is a polynomial. If so, write the polynomial in standard form.**

23. $3x + 4x^3 - 5$ 24. $5x^4 - 2x^2 + x^{-2}$
25. $\sqrt{x^2 - x^4}$ 26. $\dfrac{x^2 + 2x - 3}{6}$

Performing Operations with Polynomials **In Exercises 27–40, perform the operations and write the result in standard form.**

✓ 27. $(t^2 - 3) + (6t^2 - 4t)$
28. $(4x + 1) + (-3x^2 - x + 9)$
29. $(8x + 5) - (6x - 12)$
30. $(x^2 - 5) - (2x^2 - 3x + 1)$
31. $(2x^3 - 9x^2 - 20) + (-2x^3 + 10x^2)$
32. $(y^3 - 6y + 3) + (5y^3 - 2y^2 + y - 10)$
33. $(15x^2 - 6) - (-8.1x^3 - 14.7x^2 - .17)$
34. $(15.6w - 14w - 17.4) - (16.9w^4 - 9.2w + 13)$
35. $-3z(5z - 1)$ 36. $-7x(4 - x^3)$
37. $\left(5 - \frac{3}{2}y\right)(4y)$ 38. $\left(\frac{1}{6}x + 1\right)(-2x^2)$
39. $3x(x^2 - 2x + 1)$ 40. $y^2(4y^2 + 2y - 3)$

Multiplying Polynomials **In Exercises 41–68, multiply or find the special product.**

41. $(x + 3)(x + 4)$ 42. $(x - 5)(x + 10)$
✓ 43. $(3x - 5)(2x + 1)$ 44. $(7x - 2)(4x - 3)$
45. $(2 - 5x)^2$ 46. $(5x + 8y)^2$
47. $(x - 9)(x + 9)$ 48. $(5x + 6)(5x - 6)$
49. $(x + 2y)(x - 2y)$ 50. $(4a + 5b)(4a - 5b)$
51. $(2r^2 - 5)(2r^2 + 5)$ 52. $(3a^3 - 4b^2)(3a^3 + 4b^2)$
53. $(x + 1)^3$ 54. $(y - 4)^3$
55. $(2x - y)^3$ 56. $(3x + 2y)^3$
57. $\left(\frac{1}{4}x - 3\right)\left(\frac{1}{4}x + 3\right)$ 58. $\left(2x + \frac{1}{6}\right)\left(2x - \frac{1}{6}\right)$
59. $(2.4x + 3)^2$ 60. $(1.8y - 5)^2$
✓ 61. $(-x^2 + x - 5)(3x^2 + 4x + 1)$
62. $(x^2 + 3x + 2)(2x^2 - x + 4)$

✓ **63.** $[(x + z) + 5][(x + z) - 5]$

64. $[(x - 3y) + z][(x - 3y) - z]$

65. $[(x - 3) + y]^2$ **66.** $[(x + 1) - y]^2$

67. $5x(x + 1) - 3x(x + 1)$

68. $(2x - 1)(x + 3) + 3(x + 3)$

Removing Common Factors **In Exercises 69–74, factor out the common factor.**

69. $5x - 40$ **70.** $4y + 20$

71. $2x^3 - 6x$ **72.** $3z^3 - 6z^2 + 9z$

✓ **73.** $3x(x - 5) + 8(x - 5)$ **74.** $(5x - 4)^2 + (5x - 4)$

Factoring the Difference of Two Squares **In Exercises 75–82, factor the difference of two squares.**

75. $x^2 - 64$ **76.** $x^2 - 81$

✓ **77.** $48y^2 - 27$ **78.** $50 - 98z^2$

79. $4x^2 - \frac{1}{9}$ **80.** $\frac{25}{36}y^2 - 49$

✓ **81.** $(x - 1)^2 - 4$ **82.** $25 - (z + 5)^2$

Factoring a Perfect Square Trinomial **In Exercises 83–90, factor the perfect square trinomial.**

83. $x^2 - 4x + 4$ **84.** $x^2 + 10x + 25$

85. $x^2 + x + \frac{1}{4}$ **86.** $x^2 - \frac{4}{3}x + \frac{4}{9}$

✓ **87.** $4x^2 - 12x + 9$ **88.** $25z^2 - 10z + 1$

89. $4x^2 - \frac{4}{3}x + \frac{1}{9}$ **90.** $9y^2 - \frac{3}{2}y + \frac{1}{16}$

Factoring the Sum or Difference of Cubes **In Exercises 91–100, factor the sum or difference of cubes.**

✓ **91.** $x^3 - 64$ **92.** $z^3 - 216$

✓ **93.** $x^3 + 1$ **94.** $y^3 + 125$

95. $x^3 - \frac{8}{27}$ **96.** $x^3 + \frac{8}{125}$

97. $8x^3 - 1$ **98.** $27x^3 + 64$

99. $(x + 2)^3 - y^3$ **100.** $(x - 3y)^3 - 8z^3$

Factoring a Trinomial **In Exercises 101–114, factor the trinomial.**

101. $x^2 + x - 2$ **102.** $x^2 + 6x + 8$

✓ **103.** $s^2 - 5s + 6$ **104.** $t^2 - t - 6$

105. $20 - y - y^2$ **106.** $24 + 5z - z^2$

107. $3x^2 - 5x + 2$ **108.** $3x^2 + 13x - 10$

109. $2x^2 - x - 1$ **110.** $2x^2 - x - 21$

✓ **111.** $5x^2 + 26x + 5$ **112.** $8x^2 - 45x - 18$

113. $-5u^2 - 13u + 6$ **114.** $-6x^2 + 23x + 4$

Factoring by Grouping **In Exercises 115–120, factor by grouping.**

✓ **115.** $x^3 - x^2 + 2x - 2$ **116.** $x^3 + 5x^2 - 5x - 25$

✓ **117.** $6x^2 + x - 2$ **118.** $3x^2 + 10x + 8$

119. $x^3 - 5x^2 + x - 5$ **120.** $x^3 - x^2 + 3x - 3$

Factoring an Expression Completely **In Exercises 121–148, completely factor the expression.**

121. $10x^2 - 40$ **122.** $7z^2 - 63$

123. $y^3 - y$ **124.** $x^3 - 9x^2$

125. $x^2 - 2x + 1$ **126.** $9x^2 - 6x + 1$

127. $1 - 4x + 4x^2$ **128.** $16 - 6x - x^2$

129. $2x^2 + 4x - 2x^3$ **130.** $7y^2 + 15y - 2y^3$

131. $9x^2 + 10x + 1$ **132.** $13x + 6 + 5x^2$

133. $\frac{1}{8}x^2 - \frac{1}{96}x - \frac{1}{16}$ **134.** $\frac{1}{81}x^2 + \frac{2}{9}x - 8$

135. $3x^3 + x^2 + 15x + 5$ **136.** $5 - x + 5x^2 - x^3$

137. $3u - 2u^2 + 6 - u^3$ **138.** $x^4 - 4x^3 + x^2 - 4x$

139. $2x^3 + x^2 - 8x - 4$ **140.** $3x^3 + x^2 - 27x - 9$

141. $(x^2 + 1)^2 - 4x^2$ **142.** $(x^2 + 8)^2 - 36x^2$

143. $3t^3 + 24$ **144.** $4x^3 - 32$

145. $4x(2x - 1) + 2(2x - 1)^2$

146. $5(3 - 4x)^2 - 8(3 - 4x)(5x - 1)$

147. $2(x + 1)(x - 3)^2 - 3(x + 1)^2(x - 3)$

148. $7(3x + 2)^2(1 - x)^2 + (3x + 2)(1 - x)^3$

149. MODELING DATA

After 2 years, an investment of \$1000 compounded annually at an interest rate r will yield an amount of $1000(1 + r)^2$.

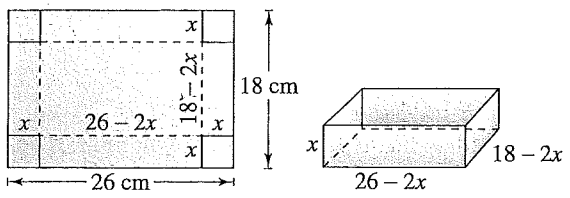
(a) Write this polynomial in standard form.

(b) Use a calculator to evaluate the polynomial for the values of r shown in the table.

r	$2\frac{1}{2}\%$	3%	4%	$4\frac{1}{2}\%$	5%
$1000(1 + r)^2$					

(c) What conclusion can you make from the table?

150. Manufacturing A shipping company is constructing an open box made by cutting squares out of the corners of a piece of cardboard that is 18 centimeters by 26 centimeters (see figure). The edge of each cut-out square is x centimeters. Find the volume of the box in terms of x. Find the volume when $x = 1$, $x = 2$, and $x = 3$.



115. $64^{1/3}$ **116.** $-\sqrt{144}$ **117.** $\sqrt[5]{32}$
118. $(614.125)^{1/3}$ **119.** $(-216)^{1/3}$ **120.** $\sqrt[5]{-243}$
121. $81^{3/4}$ **122.** $\sqrt[4]{16^5}$ **123.** $\frac{2}{|x|}$
124. $xy^{1/3}$, $x \neq 0, y \neq 0$ **125.** $\frac{1}{x^3}$, $x > 0$ **126.** $\frac{x}{5}$, $x > 0$
127. $\frac{1}{8}$ **128.** $\frac{2}{3}$ **129.** -3 **130.** -625
131. (a) $2\sqrt[4]{2}$ (b) $\sqrt[8]{2x}$
132. (a) $3\sqrt[4]{3(x+1)}$ (b) $|a|\sqrt[6]{10ab}$ **133.** 0.026 in.
134. Paper: 7.75×10^7 Plastics: 3×10^7
Metals: 2.1×10^7 Yard waste: 3.3×10^7
Glass: 1.225×10^7 Other: 7.625×10^7
135. Brazil: 1.02×10^4 Ireland: 3.86×10^4
China: 6.66×10^3 India: 3.07×10^3
Germany: 3.41×10^4 Mexico: 1.33×10^4
Iran: 1.152×10^4
136. $t \approx 13.29$ sec
137. True. $x^{k+1}/x = x^k x/x = x^k$, $(x \neq 0)$
138. False. $(a^n)^k = a^{nk}$. In general, $nk \neq n^k$.
139. $1 = \frac{a^n}{a^n} = a^{n-n} = a^0$
140. (a) Multiply the exponent of each factor in the parentheses by -2. Then, put the factors with positive exponents in the numerator and the factors with negative exponents in the denominator. Finally, simplify the factor 3^2 in the denominator.

$$\left(3x^3y^{-2}\right)^{-2} = 3^{-2}x^{-6}y^4 = \frac{y^4}{3^2x^6} = \frac{y^4}{9x^6}$$

(b) No. Four is a perfect square, and there is still a radical in the denominator.

$$\sqrt{\frac{4}{x^3}} = \frac{2}{\sqrt{x^3}} = \frac{2}{\sqrt{x^3}} \cdot \frac{\sqrt{x^3}}{\sqrt{x^3}} = \frac{2\sqrt{x^3}}{x^3} = \frac{2x\sqrt{x}}{x^3} = \frac{2\sqrt{x}}{x^2}$$

141. When any positive integer is squared, the unit's digit is 0, 1, 4, 5, 6, or 9. Therefore, $\sqrt{5233}$ is not an integer.
142. No. Rationalizing the denominator produces a number equivalent to the original fraction; squaring does not.

Section P.3 (page 31)

1. n, a_n **2.** monomial **3.** First, Outer, Inner, Last
4. prime **5.** When each of its factors is prime
6. (1) Factor out any common factors using the Distributive Property.
(2) Factor according to one of the special polynomial forms.
(3) Factor as $ax^2 + bx + c = (mx + r)(nx + s)$.
(4) Factor by grouping.
7. d **8.** e **9.** b **10.** a **11.** f **12.** c
13. Answers will vary, but first term is $-2x^3$.
14. Answers will vary, but first term is $8x^5$.
15. Answers will vary, but first term has the form $-ax^4$, $a > 0$.
16. Answers will vary. Sample answer: $8x^3 + 3x + 14$
17. $4x^2 + 3x + 2$
Degree: 2; leading coefficient: 4
18. $-3x^4 + x^2 - 4$
Degree: 4; leading coefficient: -3
19. $x^7 - 8$
Degree: 7; leading coefficient: 1
20. $-x^3 + 23$
Degree: 3; leading coefficient: -1
21. $-2x^5 + 6x^4 - x + 1$
Degree: 5; leading coefficient: -2
22. $8x + 7$
Degree: 1; leading coefficient: 8
23. Polynomial: $4x^3 + 3x - 5$ **24.** Not a polynomial
25. Not a polynomial **26.** Polynomial: $\frac{1}{6}x^2 + \frac{1}{3}x - \frac{1}{2}$
27. $7t^2 - 4t - 3$ **28.** $-3x^2 + 3x + 10$ **29.** $2x + 17$
30. $-x^2 + 3x - 6$ **31.** $x^2 - 20$
32. $6y^3 - 2y^2 - 5y - 7$ **33.** $8.1x^3 + 29.7x^2 + 11$
34. $-16.9w^4 + 10.8w - 30.4$ **35.** $-15z^2 + 3z$
36. $7x^4 - 28x$ **37.** $-6y^2 + 20y$ **38.** $-\frac{1}{3}x^3 - 2x^2$
39. $3x^3 - 6x^2 + 3x$ **40.** $4y^4 + 2y^3 - 3y^2$
41. $x^2 + 7x + 12$ **42.** $x^2 + 5x - 50$ **43.** $6x^2 - 7x - 5$
44. $28x^2 - 29x + 6$ **45.** $25x^2 - 20x + 4$
46. $25x^2 + 80xy + 64y^2$ **47.** $x^2 - 81$
48. $25x^2 - 36$ **49.** $x^2 - 4y^2$ **50.** $16a^2 - 25b^2$
51. $4r^4 - 25$ **52.** $9a^6 - 16b^4$ **53.** $x^3 + 3x^2 + 3x + 1$
54. $y^3 - 12y^2 + 48y - 64$ **55.** $8x^3 - 12x^2y + 6xy^2 - y^3$
56. $27x^3 + 54x^2y + 36xy^2 + 8y^3$ **57.** $\frac{1}{16}x^2 - 9$
58. $4x^2 - \frac{1}{36}$ **59.** $5.76x^2 + 14.4x + 9$
60. $3.24y^2 - 18y + 25$ **61.** $-3x^4 - x^3 - 12x^2 - 19x - 5$
62. $2x^4 + 5x^3 + 5x^2 + 10x + 8$ **63.** $x^2 + 2xz + z^2 - 25$
64. $x^2 - 6xy + 9y^2 - z^2$
65. $x^2 + 2xy + y^2 - 6y - 6x + 9$
66. $x^2 + y^2 - 2xy + 2x - 2y + 1$ **67.** $2x^2 + 2x$
68. $2x^2 + 8x + 6$ **69.** $5(x - 8)$ **70.** $4(y + 5)$
71. $2x(x^2 - 3)$ **72.** $3z(z^2 - 2z + 3)$
73. $(x - 5)(3x + 8)$ **74.** $(5x - 4)(5x - 3)$
75. $(x + 8)(x - 8)$ **76.** $(x - 9)(x + 9)$
77. $3(4y + 3)(4y - 3)$ **78.** $-2(7z + 5)(7z - 5)$
79. $\left(2x - \frac{1}{3}\right)\left(2x + \frac{1}{3}\right)$ **80.** $\left(\frac{5}{6}y - 7\right)\left(\frac{5}{6}y + 7\right)$
81. $[(x - 1) - 2][(x - 1) + 2] = (x - 3)(x + 1)$
82. $-z(z + 10)$ **83.** $(x - 2)^2$ **84.** $(x + 5)^2$
85. $\left(x + \frac{1}{2}\right)^2$ **86.** $\left(x - \frac{2}{3}\right)^2$ **87.** $(2x - 3)^2$
88. $(5z - 1)^2$ **89.** $\left(2x - \frac{1}{3}\right)^2$
90. $\left(3y - \frac{1}{4}\right)^2 = \frac{(12y - 1)^2}{16}$ **91.** $(x - 4)(x^2 + 4x + 16)$
92. $(z - 6)(z^2 + 6z + 36)$ **93.** $(x + 1)\left(x^2 - x + 1\right)$
94. $(y + 5)\left(y^2 - 5y + 25\right)$ **95.** $\left(x - \frac{2}{3}\right)\left(x^2 + \frac{2}{3}x + \frac{4}{9}\right)$
96. $\left(x + \frac{2}{5}\right)\left(x^2 - \frac{2}{5}x + \frac{4}{25}\right)$
97. $(2x - 1)(4x^2 + 2x + 1)$
98. $(3x + 4)(9x^2 - 12x + 16)$
99. $(x + 2 - y)(x^2 + 4x + 4 + xy + 2y + y^2)$
100. $(x - 3y - 2z)(x^2 - 6xy + 9y^2 + 2xz - 6yz + 4z^2)$
101. $(x - 1)(x + 2)$ **102.** $(x + 4)(x + 2)$
103. $(s - 2)(s - 3)$ **104.** $(t - 3)(t + 2)$
105. $-(y - 4)(y + 5)$ **106.** $(8 - z)(3 + z)$
107. $(3x - 2)(x - 1)$ **108.** $(3x - 2)(x + 5)$
109. $(2x + 1)(x - 1)$ **110.** $(2x - 7)(x + 3)$
111. $(5x + 1)(x + 5)$ **112.** $(8x + 3)(x - 6)$
113. $-(5u - 2)(u + 3)$ **114.** $(-6x - 1)(x - 4)$
115. $(x - 1)(x^2 + 2)$ **116.** $(x^2 - 5)(x + 5)$

117. $(3x + 2)(2x - 1)$ **118.** $(x + 2)(3x + 4)$
119. $(x^2 + 1)(x - 5)$ **120.** $(x^2 + 3)(x - 1)$
121. $10(x - 2)(x + 2)$ **122.** $7(z + 3)(z - 3)$
123. $y(y + 1)(y - 1)$ **124.** $x^2(x - 9)$ **125.** $(x - 1)^2$
126. $(3x - 1)^2$ **127.** $(2x - 1)^2$ **128.** $(8 + x)(2 - x)$
129. $-2x(x - 2)(x + 1)$ **130.** $-y(2y + 3)(y - 5)$
131. $(9x + 1)(x + 1)$ **132.** $(5x + 3)(x + 2)$
133. $\frac{1}{96}(3x + 2)(4x - 3)$ **134.** $\left(\frac{1}{9}x - 2\right)\left(\frac{1}{9}x + 4\right)$
135. $(3x + 1)(x^2 + 5)$ **136.** $(5 - x)(1 + x^2)$
137. $(u + 2)(3 - u^2)$ **138.** $x(x^2 + 1)(x - 4)$
139. $(x - 2)(x + 2)(2x + 1)$ **140.** $(x + 3)(x - 3)(3x + 1)$
141. $(x + 1)^2(x - 1)^2$ **142.** $(x + 2)(x + 4)(x - 2)(x - 4)$
143. $3(t + 2)(t^2 - 2t + 4)$ **144.** $4(x - 2)(x^2 + 2x + 4)$
145. $2(2x - 1)(4x - 1)$ **146.** $(3 - 4x)(23 - 60x)$
147. $-(x + 1)(x - 3)(x + 9)$
148. $5(1 - x)^2(3x + 2)(4x + 3)$
149. (a) $1000r^2 + 2000r + 1000$

(b)

r	$2\frac{1}{2}\%$	3%	4%
$1000(1 + r)^2$	1050.63	1060.90	1081.60

r	$4\frac{1}{2}\%$	5%
$1000(1 + r)^2$	1092.03	1102.50

(c) The amount increases with increasing r.

150. $V = x(26 - 2x)(18 - 2x)$
$= 4x(x - 13)(x - 9)$

x (cm)	1	2	3
V (cm^3)	384	616	720

151. (a) $T(x) = 0.0475x^2 + 1.099x + 0.23$

(b)

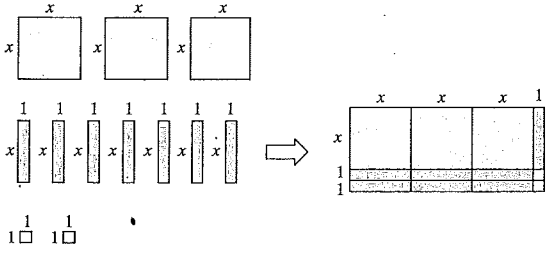
x (mi/h)	30	40	55
T (ft)	75.95	120.19	204.36

(c) Stopping distance increases as speed increases.

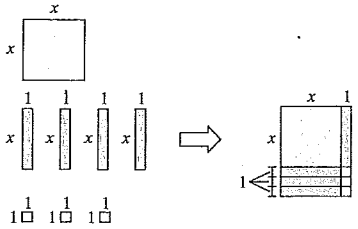
152. (a) About 233.6 lb
(b) The difference decreases as the span increases.

153. a **154.** b

155.



156.



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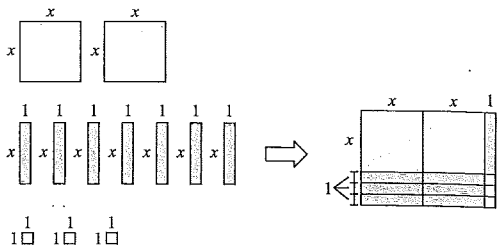

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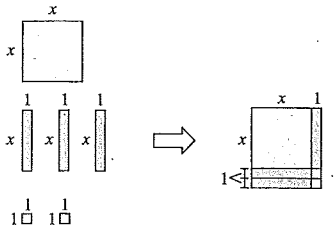


159. $4\pi(r + 1)$ **160.** $r^2(4 - \pi)$ **161.** $4(6 - x)(6 + x)$
162. $\frac{5}{8}(x + 7)(x - 1)$ **163.** $(4x^3)(2x + 1)^3(2x^2 + 2x + 1)$
164. $3x^2(x^2 + 1)^2(3x^2 + 1)$
165. $(2x - 5)^3(5x - 4)^2(70x - 107)$
166. $(x^2 - 5)^2(4x + 3)(12x^3 + 17x^2 - 40)$
167. $\frac{-8}{(5x - 1)^2}$ **168.** $\frac{14}{(2x + 3)^2}$ **169.** $-14, 14, -2, 2$
170. $1, -1, 4, -4, 11, -11$
171. $-51, 51, -15, 15, -27, 27$
172. $25, -25, 14, -14, 11, -11, 10, -10$
173. $2, -3$ **174.** $-2, -10$ **175.** $3, -8$ **176.** $9, -26$
177. (a) $V = \pi h(R - r)(R + r)$

(b) $V = 2\pi\left[\left(\frac{R + r}{2}\right)(R - r)\right]h$

178. $kx(Q - x)$
179. False. $(x^2 - 1)(x^2 + 1)$ becomes a fourth-degree polynomial.
180. False. $(x - 2)(x + 2) = x^2 - 4$ **181.** Degree: $m + n$
182. Answers will vary. Sample answer: The FOIL Method should be used to expand the binomial. When the FOIL Method is used, $(x + y)^2 = x^2 + 2xy + y^2$, which is not equal to $x^2 + y^2$.
183. Answers will vary. Sample answer: To cube a binomial difference, cube the first term. Next subtract 3 times the square of the first term multiplied by the second term. Then add 3 times the first term multiplied by the square of the second term. Lastly, subtract the cube of the second term $(x - y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$.
184. Answers will vary. Sample answer: A polynomial is in factored form when each of its factors is prime (it cannot be factored any further using integer coefficients).
185. No. $(3x - 6)(x + 1)$ is not completely factored because 3 can be factored out of $(3x - 6)$.
186. No. $(x^2 + 1) + (-x^2 + 3) = 4$, which is not a second-degree polynomial. Examples will vary.
187. A 3 was not factored out of the second binomial.
188. (a) Yes. The sum of two polynomials will have the same degree as the polynomial of greater degree unless the polynomials have equal degree and their leading coefficients are opposites.
(b) No. Same reasoning as in (a).
(c) No. Same reasoning as in (a).

P.4 Exercises

See www.CalcChat.com for worked-out solutions to odd-numbered exercises.
For instructions on how to use a graphing utility, see Appendix A.

Vocabulary and Concept Check

In Exercises 1–4, fill in the blank.

1. The set of real numbers for which an algebraic expression is defined is the _____ of the expression.
2. The quotient of two algebraic expressions is a fractional expression and the quotient of two polynomials is a _____.
3. Fractional expressions with separate fractions in the numerator, denominator, or both are called _____.
4. To simplify an expression with negative exponents, it is possible to begin by factoring out the common factor with the _____ exponent.
5. When is a rational expression in simplest form?
6. What values are excluded from the domain of a rational expression?

Procedures and Problem Solving

Finding the Domain of an Algebraic Expression **In Exercises 7–22, find the domain of the expression.**

7. $3x^2 - 4x + 7$
8. $2x^2 + 5x - 2$
9. $4x^3 + 3, \quad x \geq 0$
10. $6x^2 - 9, \quad x > 0$
11. $\frac{1}{3 - x}$
12. $\frac{x + 6}{3x + 2}$
13. $\frac{x^2 - 1}{x^2 - 2x + 1}$
14. $\frac{x^2 - 5x + 6}{x^2 - 4}$
15. $\frac{x^2 - 2x - 3}{x^2 - 6x + 9}$
16. $\frac{x^2 - x - 12}{x^2 - 8x + 16}$
17. $\sqrt{x + 7}$
18. $\sqrt{4 - x}$
19. $\sqrt{2x - 5}$
20. $\sqrt{4x + 5}$
21. $\frac{1}{\sqrt{x - 3}}$
22. $\frac{1}{\sqrt{x + 2}}$

Writing Equivalent Fractions **In Exercises 23–28, find the missing factor in the numerator such that the two fractions are equivalent.**

23. $\frac{5}{2x} = \frac{5(\quad)}{6x^2}$
24. $\frac{2}{3x^2} = \frac{2(\quad)}{3x^4}$
25. $\frac{3}{4} = \frac{3(\quad)}{4(x + 1)}$
26. $\frac{2}{5} = \frac{2(\quad)}{5(x - 3)}$
27. $\frac{x - 1}{4(x + 2)} = \frac{(x - 1)(\quad)}{4(x + 2)^2}$
28. $\frac{x + 3}{2(x - 1)} = \frac{(x + 3)(\quad)}{2(x - 1)^2}$

Simplifying a Rational Expression **In Exercises 29–46, write the rational expression in simplest form.**

29. $\frac{15x^2}{10x}$
30. $\frac{18y^2}{60y^5}$
31. $\frac{3xy}{xy + x}$
32. $\frac{2x^2y}{xy - y}$
33. $\frac{4y - 8y^2}{10y - 5}$
34. $\frac{9x^2 + 9x}{2x + 2}$
35. $\frac{x - 5}{10 - 2x}$
36. $\frac{12 - 4x}{x - 3}$
37. $\frac{y^2 - 16}{y + 4}$
38. $\frac{x^2 - 25}{5 - x}$
39. $\frac{x^3 + 5x^2 + 6x}{x^2 - 4}$
40. $\frac{x^2 + 8x - 20}{x^2 + 11x + 10}$
41. $\frac{y^2 - 7y + 12}{y^2 + 3y - 18}$
42. $\frac{-10 - x}{x^2 + 11x + 10}$
43. $\frac{2 - x + 2x^2 - x^3}{x - 2}$
44. $\frac{x^2 - 9}{x^3 + x^2 - 9x - 9}$
45. $\frac{z^3 - 8}{z^2 + 2z + 4}$
46. $\frac{y^3 - 2y^2 - 3y}{y^3 + 1}$

Comparing Rational Expressions **In Exercises 47 and 48, complete the table. What can you conclude?**

47.

x	0	1	2	3	4	5	6
$\frac{x^2 - 2x - 3}{x - 3}$							
$x + 1$							

48.

x	0	1	2	3	4	5	6
$\frac{x - 3}{x^2 - x - 6}$							
$\frac{1}{x + 2}$							

Error Analysis **In Exercises 49 and 50, describe the error.**

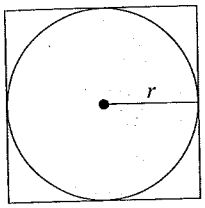
49. $\dfrac{5x^3}{2x^3+4} = \dfrac{5x^3}{2x^3+4} = \dfrac{5}{2+4} = \dfrac{5}{6}$

50. $\dfrac{x^3+25x}{x^2-2x-15} = \dfrac{x(x^2+25)}{(x-5)(x+3)}$

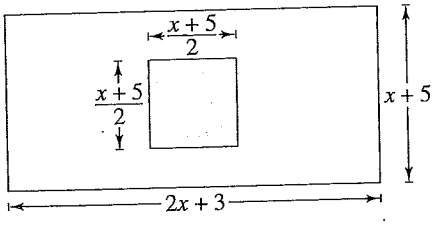
$= \dfrac{x(x-5)(x+5)}{(x-5)(x+3)} = \dfrac{x(x+5)}{x+3}$

Geometry **In Exercises 51 and 52, find the ratio of the area of the shaded portion of the figure to the total area of the figure.**

51.



52.



Multiplying or Dividing Rational Expressions **In Exercises 53–60, perform the multiplication or division and simplify.**

53. $\dfrac{5}{x-1} \cdot \dfrac{x-1}{25(x-2)}$

54. $\dfrac{x+13}{x^3(3-x)} \cdot \dfrac{x(x-3)}{5}$

55. $\dfrac{r}{r-1} \div \dfrac{r^2}{r^2-1}$

56. $\dfrac{4y-16}{5y+15} \div \dfrac{4-y}{2y+6}$

✓ **57.** $\dfrac{t^2-t-6}{t^2+6t+9} \cdot \dfrac{t+3}{t^2-4}$

58. $\dfrac{y^3-8}{2y^3} \cdot \dfrac{4y}{y^2-5y+6}$

✓ **59.** $\dfrac{3(x+y)}{4} \div \dfrac{x+y}{2}$

60. $\dfrac{x+2}{5(x-3)} \div \dfrac{x-2}{5(x-3)}$

Adding or Subtracting Rational Expressions **In Exercises 61–70, perform the addition or subtraction and simplify.**

61. $\dfrac{5}{x-1} + \dfrac{x}{x-1}$

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

✓ **63.** $\dfrac{6}{2x+1} - \dfrac{x}{x+3}$

64. $\dfrac{3}{x-1} + \dfrac{5x}{3x+4}$

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

66. $\dfrac{2x}{x-5} - \dfrac{5}{5-x}$

67. $\dfrac{1}{x^2-x-2} - \dfrac{x}{x^2-5x+6}$

68. $\dfrac{2}{x^2-x-2} + \dfrac{10}{x^2+2x-8}$

✓ **69.** $-\dfrac{1}{x} + \dfrac{2}{x^2+1} - \dfrac{1}{x^3+x}$

70. $\dfrac{2}{x+1} + \dfrac{2}{x-1} + \dfrac{1}{x^2-1}$

Error Analysis **In Exercises 71 and 72, describe the error.**

71. $\dfrac{x-4}{x} + \dfrac{2x-3}{x+1} = \dfrac{3x-7}{2x+1}$

72. $\dfrac{x+4}{x+2} - \dfrac{3x-8}{x+2} = \dfrac{x+4-3x-8}{x+2}$

$= \dfrac{-2x-4}{x+2} = \dfrac{-2(x+2)}{x+2} = -2$

Simplifying a Complex Fraction **In Exercises 73–80, simplify the complex fraction.**

73. $\dfrac{\left(\dfrac{x}{2}-1\right)}{(x-2)}$

74. $\dfrac{(x-4)}{\left(\dfrac{x}{4}-\dfrac{4}{x}\right)}$

75. $\dfrac{\left[\dfrac{x^2}{(x+1)^2}\right]}{\left[\dfrac{x}{(x+1)^3}\right]}$

76. $\dfrac{\left(\dfrac{x^2-1}{x}\right)}{\left[\dfrac{(x-1)^2}{x}\right]}$

✓ **77.** $\dfrac{\left[\dfrac{1}{(x+h)^2}-\dfrac{1}{x^2}\right]}{h}$

78. $\dfrac{\left(\dfrac{x+h}{x+h+1}-\dfrac{x}{x+1}\right)}{h}$

79. $\dfrac{\left(\sqrt{x}-\dfrac{1}{2\sqrt{x}}\right)}{\sqrt{x}}$

80. $\dfrac{\left(\dfrac{t^2}{\sqrt{t^2+1}}-\sqrt{t^2+1}\right)}{t^2}$

∫ Simplifying an Expression with Negative Exponents **In Exercises 81–86, simplify the expression by removing the common factor with the lesser exponent.**

81. $x^5 - 2x^{-2}$

82. $x^5 - 5x^{-3}$

✓ **83.** $x^2(x^2+1)^{-5} - (x^2+1)^{-4}$

84. $2x(x-5)^{-3} - 4x^2(x-5)^{-4}$

85. $2x^2(x-1)^{1/2} - 5(x-1)^{-1/2}$

86. $4x^3(2x-1)^{3/2} - 2x(2x-1)^{-1/2}$

Section P.4 (page 42)

1. domain **2.** rational expression
3. complex fractions **4.** lesser
5. When its numerator and denominator have no factors in common aside from ± 1
6. Values that make the denominator zero
7. All real numbers x **8.** All real numbers x
9. All nonnegative real numbers x
10. All positive real numbers x
11. All real numbers x except $x = 3$
12. All real numbers x except $x = -\frac{2}{3}$
13. All real numbers x except $x = 1$
14. All real numbers x except $x = \pm 2$
15. All real numbers x except $x = 3$
16. All real numbers x except $x = 4$
17. All real numbers x such that $x \geq -7$
18. All real numbers x such that $x \leq 4$
19. All real numbers x such that $x \geq \frac{5}{2}$
20. All real numbers x such that $x \geq -\frac{5}{4}$
21. All real numbers x such that $x > 3$
22. All real numbers x such that $x > -2$
23. $3x$, $x \neq 0$ **24.** x^2, $x \neq 0$ **25.** $(x + 1)$, $x \neq -1$
26. $x - 3$, $x \neq 3$ **27.** $x + 2$, $x \neq -2$
28. $x - 1$, $x \neq 1$ **29.** $\frac{3x}{2}$, $x \neq 0$ **30.** $\frac{3}{10y^3}$
31. $\frac{3y}{y+1}$, $x \neq 0$ **32.** $\frac{2x^2}{x-1}$, $y \neq 0$
33. $-\frac{4y}{5}$, $y \neq \frac{1}{2}$ **34.** $\frac{9x}{2}$, $x \neq -1$ **35.** $-\frac{1}{2}$, $x \neq 5$
36. -4, $x \neq 3$ **37.** $y - 4$, $y \neq -4$
38. $-(x + 5)$, $x \neq 5$ **39.** $\frac{x(x+3)}{x-2}$, $x \neq -2$
40. $\frac{x-2}{x+1}$, $x \neq -10$ **41.** $\frac{y-4}{y+6}$, $y \neq 3$
42. $-\frac{1}{x+1}$, $x \neq -10$ **43.** $-(x^2 + 1)$, $x \neq 2$
44. $\frac{1}{x+1}$, $x \neq \pm 3$ **45.** $z - 2$ **46.** $\frac{y(y-3)}{y^2-y+1}$, $y \neq -1$

47.

x	0	1	2	3	4	5	6
$\frac{x^2-2x-3}{x-3}$	1	2	3	Undef.	5	6	7
$x + 1$	1	2	3	4	5	6	7

The expressions are equivalent except at $x = 3$.

48.

x	0	1	2	3	4	5	6
$\frac{x-3}{x^2-x-6}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	Undef.	$\frac{1}{6}$	$\frac{1}{7}$	$\frac{1}{8}$
$\frac{1}{x+2}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{7}$	$\frac{1}{8}$

The expressions are equivalent except at $x = 3$.

49. Only common factors of the numerator and denominator can be canceled. In this case, factors of terms were incorrectly canceled.
50. $x^2 + 25$ does not factor to $(x - 5)(x + 5)$.
51. $\frac{\pi}{4}$ **52.** $\frac{x+5}{4(2x+3)}$, $x \neq -5$ **53.** $\frac{1}{5(x-2)}$, $x \neq 1$
54. $-\frac{x+13}{5x^2}$, $x \neq 3$ **55.** $\frac{r+1}{r}$, $r \neq 1, -1$
56. $-\frac{8}{5}$, $y \neq -3, 4$ **57.** $\frac{t-3}{(t+3)(t-2)}$, $t \neq -2$
58. $\frac{2(y^2+2y+4)}{y^2(y-3)}$, $y \neq 2$ **59.** $\frac{3}{2}$, $x \neq -y$
60. $\frac{x+2}{x-2}$, $x \neq 3$ **61.** $\frac{x+5}{x-1}$ **62.** $\frac{3x-2}{x+3}$
63. $\frac{2x^2-5x-18}{(2x+1)(x+3)}$ **64.** $\frac{5x^2+4x+12}{(x-1)(3x+4)}$
65. $-\frac{2}{x-2}$ **66.** $\frac{2x+5}{x-5}$
67. $-\frac{x^2+3}{(x+1)(x-2)(x-3)}$ **68.** $\frac{6(2x+3)}{(x-2)(x+1)(x+4)}$
69. $-\frac{x^2-2x+2}{x(x^2+1)}$ **70.** $\frac{4x+1}{(x-1)(x+1)}$
71. A common denominator was not found before the fractions were added.
72. The negative sign in front of the second fraction was not distributed through the numerator before the fractions were added.
73. $\frac{1}{2}$, $x \neq 2$ **74.** $\frac{4x}{x+4}$, $x \neq 0, 4$
75. $x(x + 1)$, $x \neq -1, 0$ **76.** $\frac{x+1}{x-1}$, $x \neq 0$
77. $-\frac{2x+h}{x^2(x+h)^2}$, $h \neq 0$ **78.** $\frac{1}{(x+h+1)(x+1)}$, $h \neq 0$
79. $\frac{2x-1}{2x}$, $x > 0$ **80.** $-\frac{1}{t^2\sqrt{t^2+1}}$
81. $x^{-2}(x^7 - 2) = \frac{x^7-2}{x^2}$ **82.** $x^{-3}(x^8 - 5) = \frac{x^8-5}{x^3}$
83. $-\frac{1}{(x^2+1)^5}$ **84.** $\frac{-2x(x+5)}{(x-5)^4}$ **85.** $\frac{2x^3-2x^2-5}{(x-1)^{1/2}}$
86. $\frac{2x(8x^4-8x^3+2x^2-1)}{(2x-1)^{1/2}}$ **87.** $\frac{2x^2-1}{x^{5/2}}$
88. $\frac{3(1-2x)}{2x^{5/2}}$ **89.** $-\frac{(x-1)(x^2+x+2)}{x^2(x^2+1)^{3/2}}$ **90.** $\frac{4(x^2-2)}{x^{11/2}}$
91. $\frac{-2(3x^2+3x-5)}{\sqrt{4x+3}(x^2+5)^2}$ **92.** $\frac{(x-5)^2(5x+8)}{(2x+1)^{3/2}}$
93. $\frac{1}{\sqrt{x+2}+\sqrt{x}}$ **94.** $\frac{-1}{\sqrt{z-3}+\sqrt{z}}$
95. $\frac{1}{\sqrt{x+2}+\sqrt{2}}$, $x \neq 0$ **96.** $\frac{1}{\sqrt{x+5}+\sqrt{5}}$, $x \neq 0$
97. $\frac{1}{\sqrt{x+9}+3}$, $x \neq 0$ **98.** $\frac{1}{\sqrt{x+4}+2}$, $x \neq 0$
99. $\frac{x}{2(2x+1)}$ **100.** $\frac{8(x+2)}{(x+4)^2}$
101. (a) 6.39% (b) $\frac{288(MN-P)}{N(MN+12P)}$; 6.39%
102. (a) 4.57% (b) $\frac{288(MN-P)}{N(MN+12P)}$; 4.57%
103. (a) $\frac{1}{50}$ min (b) $\frac{x}{50}$ min (c) 2.4 min

P Review Exercises

See www.CalcChat.com for worked-out solutions to odd-numbered exercises.
For instructions on how to use a graphing utility, see Appendix A.

P.1

Identifying Subsets of Real Numbers **In Exercises 1 and 2, determine which numbers are (a) natural numbers, (b) whole numbers, (c) integers, (d) rational numbers, and (e) irrational numbers.**

1. $\{11, -14, -\frac{8}{9}, \frac{5}{2}, \sqrt{6}, 0.4\}$
2. $\{\sqrt{15}, -22, -\frac{10}{3}, 0, 5.2, \frac{3}{7}\}$

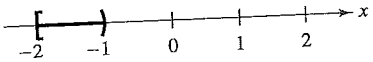
Writing an Inequality **In Exercises 3 and 4, use a calculator to find the decimal form of each rational number. If it is a nonterminating decimal, write the repeating pattern. Then plot the numbers on the real number line and place the correct inequality symbol (< or >) between them.**

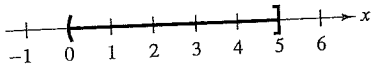
3. (a) $\frac{5}{6}$ (b) $\frac{7}{8}$
4. (a) $\frac{1}{3}$ (b) $\frac{9}{25}$

Interpreting Inequalities **In Exercises 5 and 6, (a) verbally describe the subset of real numbers represented by the inequality, (b) sketch the subset on the real number line, and (c) state whether the interval is bounded or unbounded.**

5. $x \leq 7$
6. $-3 < x \leq 6$

Using Interval Notation **In Exercises 7 and 8, use interval notation to describe the graph.**

7. 

8. 

Finding the Distance Between Two Real Numbers **In Exercises 9 and 10, find the distance between a and b.**

9. $a = -74, \quad b = 48$
10. $a = -123, \quad b = -9$

Using Absolute Value Notation **In Exercises 11 and 12, use absolute value notation to describe the situation.**

11. The distance between x and 7 is at least 6.
12. The distance between y and -30 is less than 5.

Evaluating an Expression **In Exercises 13–16, evaluate the expression for each value of x. (If not possible, state the reason.)**

Expression	*Values*	
13. $9x - 2$	(a) $x = -1$	(b) $x = 3$
14. $x^2 - 11x + 24$	(a) $x = -2$	(b) $x = 2$
15. $-2x^2 - x + 3$	(a) $x = 3$	(b) $x = -3$
16. $\frac{4x}{x - 1}$	(a) $x = -1$	(b) $x = 1$

Identifying Rules of Algebra **In Exercises 17 and 18, identify the rule of algebra illustrated by the statement.**

17. $(t^2 + 1) + 3 = 3 + (t^2 + 1)$
18. $0 + (a - 5) = a - 5$

P.2

Using Properties of Exponents **In Exercises 19–22, simplify each expression.**

19. (a) $(-2z)^3$ (b) $(a^2b^4)(3ab^{-2})$
20. (a) $\frac{(8y)^0}{y^2}$ (b) $\frac{40(b - 3)^5}{75(b - 3)^2}$
21. (a) $\frac{6^2u^3v^{-3}}{12u^{-2}v}$ (b) $\frac{3^{-4}m^{-1}n^{-3}}{9^{-2}mn^{-3}}$
22. (a) $(x^{-1} + y)^{-2}$ (b) $\left(\frac{y^{-2}}{x}\right)^{-1}\left(\frac{x^2}{y^{-2}}\right)$

Scientific Notation **In Exercises 23–26, write the number in scientific notation.**

23. 2,585,000,000
24. $-3{,}250{,}000$
25. 0.000000125
26. -0.000002104

Writing a Number in Decimal Notation **In Exercises 27–30, write the number in decimal notation.**

27. 1.28×10^5
28. -4.002×10^2
29. 1.80×10^{-5}
30. -4.02×10^{-2}

Using Properties of Radicals **In Exercises 31 and 32, use the properties of radicals to simplify the expression.**

31. $(\sqrt[4]{78})^4$
32. $\sqrt[5]{8} \cdot \sqrt[5]{4}$

Simplifying a Radical Expression **In Exercises 33–44, simplify the expression.**

33. $\sqrt{25a^2}$
34. $\sqrt[5]{64x^6}$
35. $\sqrt{\frac{81}{144}}$
36. $\sqrt[3]{\frac{125}{216}}$
37. $\sqrt[3]{\frac{2x^3}{27}}$
38. $\sqrt{\frac{75x^2}{y^4}}$
39. $\sqrt{48} - \sqrt{27}$
40. $3\sqrt{32} + 4\sqrt{98}$
41. $8\sqrt{3x} - 5\sqrt{3x}$
42. $-11\sqrt{36y} - 6\sqrt{y}$
43. $\sqrt{8x^3} + \sqrt{2x}$
44. $3\sqrt{14x^2} - \sqrt{56x^2}$

Rationalizing a Denominator **In Exercises 45 and 46, rationalize the denominator of the expression. Then simplify your answer.**

45. $\frac{1}{3 - \sqrt{5}}$
46. $\frac{1}{\sqrt{x} - 1}$

13. a) -11 b) 25

15. (a) -18 (b) -12

16. (a) 2 (b) Division by zero is undefined.

17. Commutative Property of Addition

18. Additive Identity Property **19.** (a) $-8z^3$ (b) $3a^3b^2$

20. (a) y^{-2} (b) $\frac{8}{15}(b-3)^3,\ b \neq 3$

21. (a) $\frac{3u^5}{v^4}$ (b) m^{-2}

22. (a) $\frac{x^2}{1+2xy+x^2y^2},\ x \neq 0$ (b) $x^3y^4,\ x \neq 0, y \neq 0$

23. 2.585×10^9 **24.** -3.25×10^6 **25.** 1.25×10^{-7}

26. -2.104×10^{-6} **27.** 128,000 **28.** -400.2

29. 0.000018 **30.** -0.0402 **31.** 78 **32.** 2

33. $5|a|$ **34.** $2x\sqrt[5]{2x}$ **35.** $\frac{3}{4}$ **36.** $\frac{5}{6}$ **37.** $\frac{x}{3}\sqrt[3]{2}$

38. $\frac{5|x|\sqrt{3}}{y^2}$ **39.** $\sqrt{3}$ **40.** $40\sqrt{2}$ **41.** $3\sqrt{3x}$

42. $-72\sqrt{y}$ **43.** $\sqrt{2x}(2x+1)$ **44.** $|x|\sqrt{14}$

45. $\frac{3+\sqrt{5}}{4}$ **46.** $\frac{\sqrt{x}+1}{x-1}$ **47.** $\frac{5}{2\sqrt{5}}$

48. $\frac{-3}{\sqrt{2}+\sqrt{11}}$ **49.** 32,768 **50.** $\frac{1}{16}$

51. $6x^{9/10}$ **52.** $(x-1)^{1/12},\ x \neq 1$

53. $-2x^5 - x^4 + 3x^3 + 15x^2 + 5$; degree: 5; leading coefficient: -2

54. $-2x^4 + x^3 + x^2 - x - 10$; degree: 4; leading coefficient: -2

55. $3x^2 + 7x - 1$ **56.** $8y^2 + 5y - 8$

57. $2x^3 - x^2 + 3x - 9$ **58.** $-3x^4 - 4x^3 - 9x^2 - x - 13$

59. $-2a^3 - 2a^2 + 6a$ **60.** $y^5 - 4y^4$

61. $x^2 + 13x + 36$ **62.** $5z^2 - z - 6$ **63.** $x^2 - 64$

64. $49x^2 - 16$ **65.** $x^3 - 12x^2 + 48x - 64$

66. $8x^3 - 12x^2 + 6x - 1$ **67.** $m^2 - 14m - n^2 + 49$

68. $x^2 - 2xy + y^2 - 16$

69. $(x+3)(x+5) = 5(x+3) + x(x+3)$ Distributive Property

70. $2500r^2 + 5000r + 2500$ **71.** $7(x+5)$

72. $4(b-3)$ **73.** $x(x^2-1) = x(x-1)(x+1)$

74. $(x-3)(x+4)$ **75.** $2x(x^2+9x-2)$

76. $-3x(2x^3+x^2-4)$ **77.** $(x-13)(x+13)$

78. $\left(3x-\frac{1}{5}\right)\left(3x+\frac{1}{5}\right)$ **79.** $(x+3)^2$ **80.** $(2x-1)^2$

81. $(x+6)(x^2-6x+36)$ **82.** $(4x-3)(16x^2+12x+9)$

83. $(x-9)(x+3)$ **84.** $(x-7)(x-2)$

85. $(2x+1)(x+10)$ **86.** $(3x+2)(x+4)$

87. $(x-4)(x^2-3)$ **88.** $(x-6)(x-1)(x+1)$

89. $(x-3)(2x+5)$ **90.** $(2x+3)(3x-4)$

91. All real numbers x **92.** All positive real numbers x

93. All real numbers x except $x = \frac{3}{2}$

94. All real numbers x such that $x \geq -12$

95. $\frac{x}{x^2+7},\ x \neq 0$ **96.** $\frac{6y}{y+2},\ x \neq 0$

97. $\frac{x-6}{x-5},\ x \neq -5$ **98.** $\frac{x-3}{8},\ x \neq 6$

99. $\frac{1}{x^2},\ x \neq \pm 2$ **100.** $\frac{x-1}{x-3},\ x \neq -1, \frac{1}{2}$

101. $\frac{1}{5}x(5x-6),\ x \neq 0, -\frac{3}{2}$

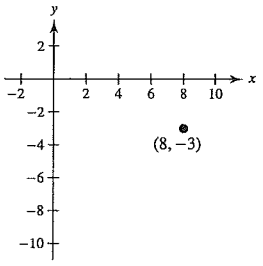
102. $\frac{2(x+3)}{x(x-1)},\ x \neq \frac{3}{2}, -3$ **103.** $\frac{x^3-x+3}{(x-1)(x+2)}$

104. $\frac{2x^3-4x^2-15x+5}{(x-4)(x+2)}$ **105.** $\frac{x+1}{x(x^2+1)}$

106. $\frac{3x}{(x-1)(x^2+x+1)}$ **107.** $-\frac{1}{xy(x+y)},\ x \neq y$

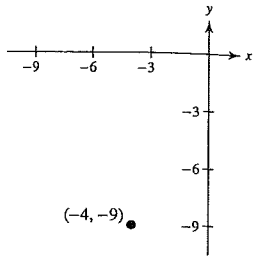
108. $\frac{4x}{2x-3},\ x \neq -\frac{3}{2}, 0$

109.



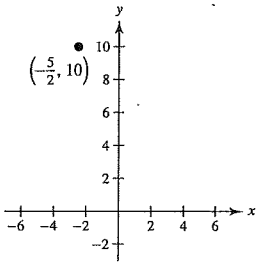
Quadrant IV

110.



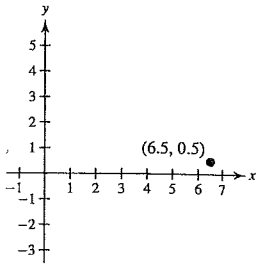
Quadrant III

111.



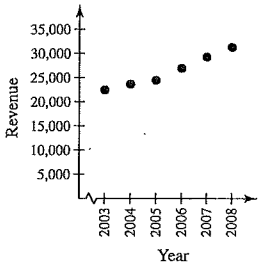
Quadrant II

112.



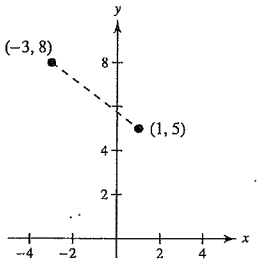
Quadrant I

113.



114. The revenues increased from 2003 to 2008.

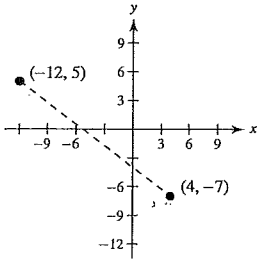
115. (a)



(b) Distance: 5

(c) Midpoint: $(-1, 6.5)$

116. (a)



(b) Distance: 20

(c) Midpoint: $(-4, -1)$