

58. $\frac{d^2}{dx^2} x^{-2} \Big|_{x=-2}$

59. $\frac{d^2}{dx^2} \sqrt{x^5} \Big|_{x=16}$


60. $\frac{d^2}{dx^2} \sqrt{x^7} \Big|_{x=4}$

61. **GENERAL: Population** The population of a city t years from now is predicted to be $P(t) = 0.25t^3 - 3t^2 + 5t + 200$ thousand people. Find $P(10)$, $P'(10)$, and $P''(10)$ and interpret your answers.

✓ 62. **GENERAL: Velocity** A rocket rises $s(t) = 8t^{5/2}$ feet in t seconds. Find its velocity and acceleration after 25 seconds.

63. **GENERAL: Velocity** The fastest baseball pitch on record (thrown by Lynn Nolan Ryan of the California Angels on August 20, 1974) was clocked at 100.9 miles per hour (148 feet per second).

a. If this pitch had been thrown straight up, its height after t seconds would have been $s(t) = -16t^2 + 148t + 5$ feet. Find the maximum height the ball would have reached.

 b. Verify your answer to part (a) by graphing the height function $y_1 = -16x^2 + 148x + 5$ on the window $[0, 10]$ by $[0, 400]$. Then TRACE along the curve to find its highest point (or use the MAXIMUM feature of your calculator).

2.6 The Chain Rule and the Generalized Power Rule

64–85. Find the derivative of each function.

64. $h(z) = (4z^2 - 3z + 1)^3$

65. $h(z) = (3z^2 - 5z - 1)^4$

66. $g(x) = (100 - x)^5$

67. $g(x) = (1000 - x)^4$

68. $f(x) = \sqrt{x^2 - x + 2}$

69. $f(x) = \sqrt{x^2 - 5x - 1}$

70. $w(z) = \sqrt[3]{6z - 1}$

71. $w(z) = \sqrt[3]{3z + 1}$

72. $h(x) = \frac{1}{\sqrt[5]{(5x + 1)^2}}$

73. $h(x) = \frac{1}{\sqrt[5]{(10x + 1)^3}}$

74. $g(x) = x^2(2x - 1)^4$

75. $g(x) = 5x(x^3 - 2)^4$

76. $y = x^3\sqrt[3]{x^3 + 1}$

✓ 77. $y = x^4\sqrt{x^2 + 1}$

78. $f(x) = [(2x^2 + 1)^4 + x^4]^3$

79. $f(x) = [(3x^2 - 1)^3 + x^3]^2$

80. $f(x) = \sqrt{(x^2 + 1)^4 - x^4}$

✓ 81. $f(x) = \sqrt{(x^3 + 1)^2 + x^2}$

82. $f(x) = (3x + 1)^4(4x + 1)^3$

✓ 83. $f(x) = (x^2 + 1)^3(x^2 - 1)^4$

84. $f(x) = \left(\frac{x + 5}{x}\right)^4$

✓ 85. $f(x) = \left(\frac{x + 4}{x}\right)^5$

86–89. Find the *second* derivative of each function.

86. $h(w) = (2w^2 - 4)^5$ 87. $h(w) = (3w^2 + 1)^4$

88. $g(z) = z^3(z + 1)^3$ 89. $g(z) = z^4(z + 1)^4$

90. Find the derivative of $(x^3 - 1)^2$ in two ways:

- By the Generalized Power Rule.
- By “squaring out” the original expression and then differentiating.

Your answers should agree.

91. Find the derivative of $g(x) = \frac{1}{x^3 + 1}$ in two ways:

- By the Quotient Rule.
- By the Generalized Power Rule.

Your answers should agree.

92. **BUSINESS: Marginal Profit** A company’s profit from producing x tons of polyurethane is $P(x) = \sqrt{x^3 - 3x + 34}$ thousand dollars (for $0 \leq x \leq 10$). Find $P'(5)$ and interpret your answer.

93. **GENERAL: Compound Interest** If \$500 is deposited in an account earning interest at r percent annually, after 3 years its value will be $V(r) = 500(1 + 0.01r)^3$ dollars. Find $V'(8)$ and interpret your answer.