1.5 Exercises

1–12 Express the given function (using ( ), ^, ×, ÷, etc.) in a format suitable for entering into a graphing utility.

1. $f(x)=1+3x+\sqrt{x}$

2. $g(x)=3x-2+\sqrt[3]{x}$

3. $h(x)=\dfrac{3x}{\sqrt{x-1}}$

4. $k(x)=\dfrac{1+\sqrt{x}}{2-3x}$

5. $u(x)=\dfrac{(-3x+16)^4}{3x+6}$

6. $v(x)=\sqrt{2+5x+\sqrt{x}}$

7. $F(x)=\left(2x^{2/3}+3x^{5/3}\right)^5$

8. $G(x)=\left(9x^{1/5}+2x^{3/5}\right)^{10}$

9. $H(x)=\ln\left(x^2+1\right)+2^{\sqrt{x}}$

10. $K(x)=\dfrac{e^{\cos x}}{\sqrt{\log\left(x^4+2\right)}}$

11. $Q(x)=\dfrac{\arctan x+1}{\left(\cos(\arcsin x)\right)^3}$

12. $R(x)=\sqrt{(\arccos x)^2+\log_2(\tan x)}$

13. During the last 5 years, the advertising manager for a corporation has gathered the following data that show the relationship between the advertising budget (in millions of dollars) and the total sales (in thousands of units).

Advertising and Sales

Advertising budget (x) (in millions)	\$4.50	\$6.50	\$3.50	\$4.20	\$2.60
Units sold (y) (in thousands)	37	46	42	32	29

a. Find the least-squares line of best fit for the data.

b. Estimate the sales if \$4 million is budgeted for advertising.

14. Records at a company for the last 5 years show the following relationship between the units sold (in thousands) and the price of a product.

Sales

Price (p)	\$8.80	\$8.00	\$7.50	\$6.90	\$6.20
Units sold (x) (in thousands)	3.8	5.2	7.3	8.0	9.6

a. Find the least-squares line of best fit for the price in terms of units sold.

b. Estimate the price that should be charged in order to sell 10,000 units.

15. The following data show the amount spent on office-building construction (in thousands) for a particular county during a 6-month period.

Office Construction

Month	Apr	May	Jun	Jul	Aug	Sep
Amount (in thousands)	\$24	\$24	\$30	\$49	\$68	\$69

a. Find the least-squares line of best fit for the data. (Let $x = 1$ correspond to January, $x = 2$ to February, etc.)

b. Estimate the amount spent on construction in October.

16. The annual revenue (in millions of dollars) for a corporation is given in the following table.

Annual Revenue

Year	2017	2018	2019	2020	2021	2022
Revenue (in millions)	$66	$82	$127	$201	$310	$315

a. Find the least-squares line of best fit for the data. (Let $x = 0$ correspond to the year 2017.)

b. Estimate the revenue for 2023.

17. The price of livestock futures is the estimated market price of livestock on the delivery date (end of the indicated month). The cattle futures (in cents per pound) for the months February through July are as follows.

Livestock Futures

Month	Feb	Mar	Apr	May	Jun	Jul
Price (cents per pound)	79.10	76.02	71.80	71.45	71.45	72.50

a. Find the least-squares line of best fit for the data. (Let $x = 1$ correspond to January, $x = 2$ to February, etc.)

b. Estimate the price for August.

18. The total number of foreign tourists visiting the United States between 2000 and 2004, as reported by the US Travel and Tourism Administration, is shown in the following table.

Foreign Tourists Visiting the United States

Year	2000	2001	2002	2003	2004
Tourists (in millions)	25.7	26.3	29.7	34.2	38.3

a. Find the least-squares line of best fit for the data. (Let x represent the number of years passed since 2000.)

b. Estimate the number of foreign tourists who visited the United States during 2006.

1.5 Technology Exercises

19–28 Determine whether there are points where we need to be careful in interpreting the result when using graphing technology to graph the given function. Find all those points and explain. Then use a graphing utility to sketch the graph, using various viewing windows.

19. $f(x) = x^4 \cos\frac{1}{x}$

20. $G(x) = \cos\frac{1}{x-2}$

21. $p(x) = \frac{1}{2}\tan(3x-2)$

22. $g(x) = \sec(2x+1)$

23. $q(x) = \frac{x^2-2x-1}{x+1}$

24. $r(x) = \frac{x^2+1}{x^2-9}$

25. $h(x) = \frac{2x^4+1}{2x^4-1}$

26. $F(x) = \ln(\cos x)$

27. $s(x) = \cos(\ln x)$

28. $t(x) = \sin(\csc x)$

29–40 Use a graphing utility to graph the given function in the window $[-10,10]$ by $[-10,10]$. Explain what appears to be wrong with the picture. Then find a more appropriate window, which reveals the significant parts of the graph, and draw the "improved" graph.

29. $f(x) = \frac{3x-25}{\sqrt{x^2+5}}$

30. $g(x) = (40+3x)\sqrt{16-x}$

31. $h(x) = (3x+4)^2(5x-25)^2$

32. $F(x) = (6x+30)^2(3x-15)^2$

33. $G(x) = 35+17x-x^2-x^3$

34. $H(x) = 210-80x+x^3$

35. $r(x) = \sqrt[3]{x^3-x^2-x-50}$

36. $u(x) = \sqrt[3]{x^4-3x^2-3x-30}$

37. $v(x) = (12-6x-x^2)^{4/3}$

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38. $f(x)=(x^3-x-100)^{1/3}$ **39.** $g(x)=x^2\sin\frac{\pi}{x-12}$ **40.** $h(x)=\sec^2\frac{x}{10}$

41–46 Use a graphing utility to graph the given function in a suitable window and find the smallest *y*-value possible. (Use only the given interval, if specified. Round your answer to four decimal places.)

41. $f(x)=x^2-104x+2724$ **42.** $g(x)=\frac{-1-x^2-3x^3}{5^x}$

43. $h(x)=x^3-17x+5;\quad -3\le x\le 5$ **44.** $F(x)=\frac{\sqrt[3]{x}-150}{5+x^2}$

45. $G(x)=x^{1.5}-8x-15$ **46.** $H(x)=x^{1.8}-x-100$

47–52 Use a graphing utility to graph the given function in a suitable window and find the greatest *y*-value possible. (Use only the given interval, if specified. Round your answer to four decimal places.)

47. $f(x)=50-2^x;\quad -10\le x\le 10$ **48.** $g(x)=(x+1)^5-1.5^{x+1}$ **49.** $h(x)=x^{17}-17^x;\quad -2\le x\le 2$

50. $k(x)=x(3^{-x})$ **51.** $F(x)=\frac{-2x}{x^2+1}$ **52.** $G(x)=\frac{3-5x}{\sqrt{3x^2+2}}$

53–58 Use a graphing utility to graph the given function, and describe the characteristics of the graph as *c* varies. Use different viewing windows.

53. $f(x)=x^2-cx$ **54.** $g(x)=\frac{1}{2}x^3-c(x^2+x+1)$ **55.** $h(x)=e^{cx}$

56. $k(x)=\ln(x^2+cx+1)$ **57.** $F(x)=\frac{x}{c}+\cos\frac{c^2x}{c}$ **58.** $G(x)=\frac{cx^2}{x+cx^3}$

59–64 Use a graphing utility to approximate the solution(s) of the given equation, rounded to four decimal places. (**Hint:** Zoom in on the *x*-intercepts or points of intersection as appropriate for each equation.)

59. $x^3-20x-2=0$ **60.** $2x^3=31x+2$ **61.** $3\cos x=\sqrt{x}$

62. $\arctan x=\frac{1}{100}x^5$ **63.** $\ln x=x-2$ **64.** $x+5=e^x$

65–70 Use appropriately large viewing windows on a graphing utility to decide which of the given functions eventually "rises faster" toward infinity.

65. $f(x)=\frac{1}{2}x^3;\quad g(x)=x^2$ **66.** $f(x)=\sqrt{x};\quad g(x)=x$ **67.** $f(x)=5\sqrt{x};\quad g(x)=\frac{1}{5}x$

68. $f(x)=\frac{1}{2}e^x;\quad g(x)=x^2$ **69.** $f(x)=5\log x+5;\quad g(x)=\frac{1}{2}x^5$ **70.** $f(x)=10\arctan x;\quad g(x)=2\sqrt[3]{x}$

71–73 Most graphing utilities have regression capabilities to fit curves other than lines to a given data set. Frequently, depending on the tendency of the data, a quadratic, an exponential, or some other type of curve provides for much better approximation. Most often the choice is the modeler's.

Use the regression capabilities of your technology to build a graphical model and then answer the questions.

71. The following table shows daytime temperatures in El Cajon, CA on a particular spring day from 6:00 a.m. to 12:00 p.m. Find the best-fitting curve and use it to predict the temperatures at 1:00 p.m. and 2:00 p.m.

Daytime Temperatures in El Cajon, CA

Time	6:00 a.m.	7:00 a.m.	8:00 a.m.	9:00 a.m.	10:00 a.m.	11:00 a.m.	12:00 p.m.
Temperature (°F)	47	50	55	61	68	73	75

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72. The following table shows the winning times of the Olympic men's 100 m dash champions. Find the best-fitting curve and use it to predict the winning times at the next three Olympics.

Olympic Men's 100 m Dash Winning Times

Year	Time (s)	Year	Time (s)	Year	Time (s)
1896	12.00	1948	10.30	1988	9.92
1900	11.00	1952	10.40	1992	9.96
1904	11.00	1956	10.50	1996	9.84
1908	10.80	1960	10.20	2000	9.87
1912	10.80	1964	10.00	2004	9.85
1920	10.80	1968	9.95	2008	9.69
1924	10.60	1972	10.14	2012	9.63
1928	10.80	1976	10.06	2016	9.81
1932	10.30	1980	10.25	2020	9.80
1936	10.30	1984	9.99		

73. The following table shows acceleration times for the Ferrari Enzo up to 130 mph. Find the best-fitting curve and use it to predict the acceleration times for the Enzo from **a.** 0 to 150 mph and **b.** 0 to 170 mph.

Acceleration Times for Ferrari Enzo

Speed (mph)	0–30	0–40	0–50	0–60	0–70	0–80	0–90	0–100	0–110	0–120	0–130
Time (s)	1.5	2.0	2.7	3.3	3.8	5.0	5.8	6.6	8.0	9.2	10.3

Source: *Car and Driver*