EXERCISES 1.4

Recognizing Functions

In Exercises 1–4, identify each function as a constant function, linear function, power function, polynomial (state its degree), rational function, algebraic function, trigonometric function, exponential function, or logarithmic function. Remember that some functions can fall into more than one category.

1. a. $f(x) = 7 - 3x$ **b.** $g(x) = \sqrt[5]{x}$

c. $h(x) = \dfrac{x^2 - 1}{x^2 + 1}$ **d.** $r(x) = 8^x$

2. a. $F(t) = t^4 - t$ **b.** $G(t) = 5^t$

c. $H(z) = \sqrt{z^3 + 1}$ **d.** $R(z) = \sqrt[3]{z^7}$

3. a. $y = \dfrac{3 + 2x}{x - 1}$ **b.** $y = x^{5/2} - 2x + 1$

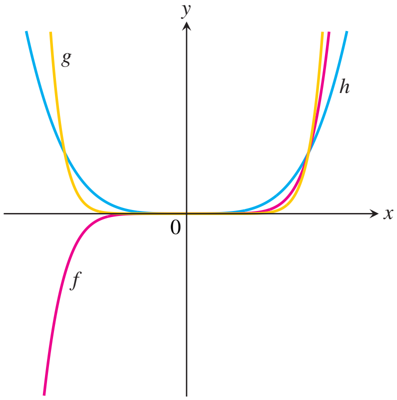
c. $y = \tan \pi x$ **d.** $y = \log_7 x$

4. a. $y = \log_5\left(\dfrac{1}{t}\right)$ **b.** $f(z) = \dfrac{z^5}{\sqrt{z} + 1}$

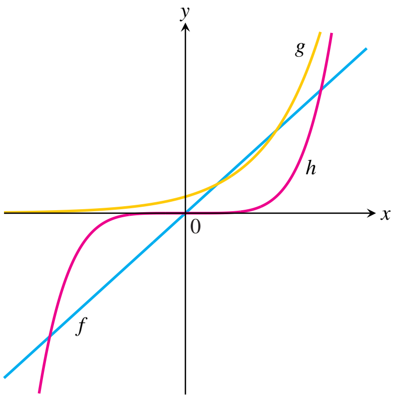
c. $g(x) = 2^{1/x}$ **d.** $w = 5\cos\left(\dfrac{t}{2} + \dfrac{\pi}{6}\right)$

In Exercises 5 and 6, match each equation with its graph. Do not use a graphing device, and give reasons for your answer.

5. a. $y = x^4$ **b.** $y = x^7$ **c.** $y = x^{10}$



6. a. $y = 5x$ **b.** $y = 5^x$ **c.** $y = x^5$



Increasing and Decreasing Functions

Graph the functions in Exercises 7–18. What symmetries, if any, do the graphs have? Specify the intervals over which the function is increasing and the intervals where it is decreasing.

7. $y = -x^3$ **8.** $y = -\dfrac{1}{x^2}$

9. $y = -\dfrac{1}{x}$ **10.** $y = \dfrac{1}{|x|}$

11. $y = \sqrt{|x|}$ **12.** $y = \sqrt{-x}$

13. $y = x^3/8$ **14.** $y = -4\sqrt{x}$

15. $y = -x^{3/2}$ **16.** $y = (-x)^{3/2}$

17. $y = (-x)^{2/3}$ **18.** $y = -x^{2/3}$

Even and Odd Functions

In Exercises 19–30, say whether the function is even, odd, or neither. Give reasons for your answer.

19. $f(x) = 3$ **20.** $f(x) = x^{-5}$

21. $f(x) = x^2 + 1$ **22.** $f(x) = x^2 + x$

23. $g(x) = x^3 + x$ **24.** $g(x) = x^4 + 3x^2 - 1$

Exercises

25. $g(x) = \dfrac{1}{x^2 - 1}$

26. $g(x) = \dfrac{x}{x^2 - 1}$

27. $h(t) = \dfrac{1}{t - 1}$

28. $h(t) = |t^3|$

29. $h(t) = 2t + 1$

30. $h(t) = 2|t| + 1$

Proportionality

In Exercises 31 and 32, assess whether the given data sets reasonably support the stated proportionality assumption. Graph an appropriate scatterplot for your investigation and, if the proportionality assumption seems reasonable, estimate the constant of proportionality.

Exercises

31. a. y is proportional to x

y	1	2	3	4	5	6	7	8
x	5.9	12.1	17.9	23.9	29.9	36.2	41.8	48.2

b. y is proportional to $x^{1/2}$

y	3.5	5	6	7	8
x	3	6	9	12	15

32. a. y is proportional to 3^x

y	5	15	45	135	405	1215	3645	10,935
x	0	1	2	3	4	5	6	7

b. y is proportional to $\ln x$

y	2	4.8	5.3	6.5	8.0	10.5	14.4	15.0
x	2.0	5.0	6.0	9.0	14.0	35.0	120.0	150.0

T **33.** The accompanying table shows the distance a car travels during the time the driver is reacting before applying the brakes, and the distance the car travels after the brakes are applied. The distances (in feet) depend on the speed of the car (in miles per hour). Test the reasonableness of the following proportionality assumptions and estimate the constants of proportionality.

a. reaction distance is proportional to speed.

b. braking distance is proportional to the square of the speed.

Speed (mph)	20	25	30	35	40	45	50	55	60	65	70	75	80
Reaction distance (ft)	22	28	33	39	44	50	55	61	66	72	77	83	88
Braking distance (ft)	20	28	41	53	72	93	118	149	182	221	266	318	376

34. In October 2002, astronomers discovered a rocky, icy mini-planet tentatively named "Quaoar" circling the sun far beyond Neptune. The new planet is about 4 billion miles from Earth in an outer fringe of the solar system known as the Kuiper Belt. Using Kepler's third law, estimate the time T it takes Quaoar to complete one full orbit around the sun.

T **35. Spring elongation** The response of a spring to various loads must be modeled to design a vehicle such as a dump truck, utility vehicle, or a luxury car that responds to road conditions in a desired way. We conducted an experiment to measure the stretch y of a spring in inches as a function of the number x of units of mass placed on the spring.

x (number of units of mass)	0	1	2	3	4	5
y (elongation in inches)	0	0.875	1.721	2.641	3.531	4.391

x (number of units of mass)	6	7	8	9	10
y (elongation in inches)	5.241	6.120	6.992	7.869	8.741

a. Make a scatterplot of the data to test the reasonableness of the hypothesis that stretch y is proportional to the mass x.

b. Estimate the constant of proportionality from your graph obtained in part (a).

c. Predict the elongation of the spring for 13 units of mass.

36. Ponderosa pines In the table, x represents the girth (distance around) of a pine tree measured in inches (in.) at shoulder height; y represents the board feet (bf) of lumber finally obtained.

x (in.)	17	19	20	23	25	28	32	38	39	41
y (bf)	19	25	32	57	71	113	123	252	259	294

Formulate and test the following two models: that usable board feet is proportional to **(a)** the square of the girth and **(b)** the cube of the girth. Does one model provide a better "explanation" than the other?