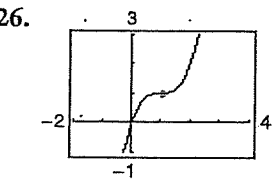
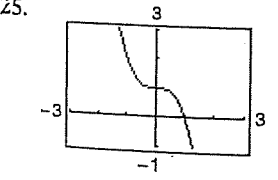
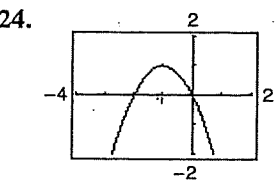
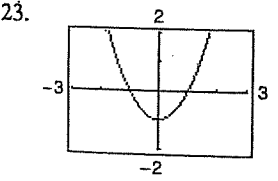
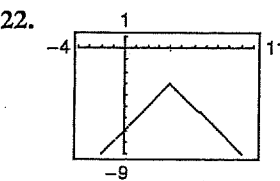
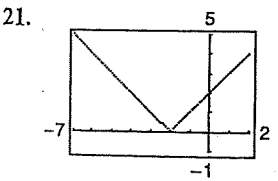
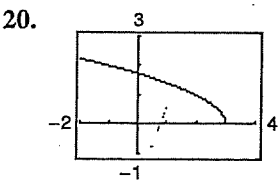
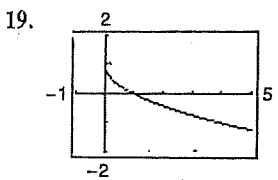
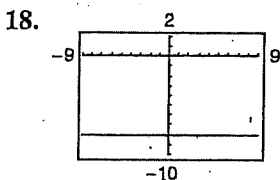
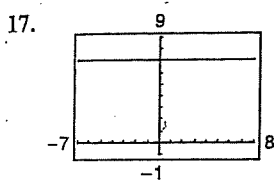
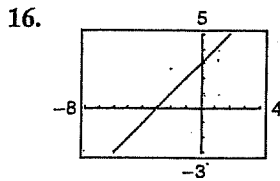
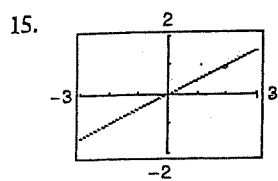


GRAPH TRANSFORMATIONS

In Exercises 15–26, identify the common function and describe the transformation shown in the graph. Write an equation for the graphed function.



In Exercises 27–32, compare the graph of the function with the graph of $f(x) = \sqrt{x}$.

- 27. $y = -\sqrt{x} - 1$
- 29. $y = \sqrt{x - 2}$
- 31. $y = \sqrt{2x}$

- 28. $y = \sqrt{x} + 2$
- 30. $y = \sqrt{x + 4}$
- 32. $y = \sqrt{-x + 3}$

In Exercises 33–38, compare the graph of the function with the graph of $f(x) = |x|$.

- 33. $y = |x + 5|$
- 35. $y = -|x|$
- 37. $y = 4|x|$
- 34. $y = |x| - 3$
- 36. $y = |-x|$
- 38. $y = \frac{1}{2}|x|$

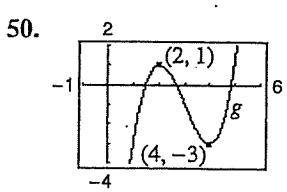
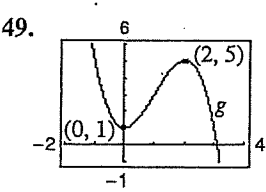
In Exercises 39–44, compare the graph of the function with the graph of $f(x) = x^3$.

- 39. $g(x) = 4 - x^3$
- 41. $h(x) = \frac{1}{4}(x + 2)^3$
- 43. $p(x) = (\frac{1}{3}x)^3 + 2$
- 40. $g(x) = -(x - 1)^3$
- 42. $h(x) = -2(x - 1)^3 + 3$
- 44. $p(x) = [3(x - 2)]^3$

In Exercises 45–48, use a graphing utility to graph the three functions in the same viewing window. Describe the graphs of g and h relative to the graph of f .

- 45. $f(x) = x^3 - 3x^2$
 $g(x) = f(x + 2)$
 $h(x) = \frac{1}{2}f(x)$
- 46. $f(x) = x^3 - 3x^2 + 2$
 $g(x) = f(x - 1)$
 $h(x) = f(3x)$
- 47. $f(x) = x^3 - 3x^2$
 $g(x) = -\frac{1}{3}f(x)$
 $h(x) = f(-x)$
- 48. $f(x) = x^3 - 3x^2 + 2$
 $g(x) = -f(x)$
 $h(x) = f(2x)$

In Exercises 49 and 50, use the graph of $f(x) = x^3 - 3x^2$ (see Exercise 45) to write a formula for the function g shown in the graph.



In Exercises 51–64, g is related to one of the six common functions on page 42. (a) Identify the common function f . (b) Describe the sequence of transformations from f to g . (c) Sketch the graph of g by hand. (d) Use function notation to write g in terms of the common function f .

- 51. $g(x) = 2 - (x + 5)^2$
- 52. $g(x) = -(x + 10)^2 + 5$
- 53. $g(x) = 3 + 2(x - 4)^2$
- 54. $g(x) = -\frac{1}{4}(x + 2)^2 - 2$
- 55. $g(x) = 3(x - 2)^3$
- 56. $g(x) = -\frac{1}{2}(x + 1)^3$
- 57. $g(x) = (x - 1)^3 + 2$
- 58. $g(x) = -(x + 3)^3 - 10$

$$15. y = 1/2 x$$

$$16. y = x + 3$$

$$17. y = 7$$

$$18. y = -8$$

$$19. y = 1 - \sqrt{x}$$

$$20. y = \sqrt{3-x}$$

$$21. y = |x+2|$$

$$22. ~~y = -|x-4| - 3~~ y = -|x-4| - 3$$

$$23. x^2 - 1$$

$$24. y = -(x+1)^2 + 1$$

$$25. y = 1 - x^3$$

$$26. y = (x-1)^3 + 1$$

$$49. g(x) = -(x^3 - 3x^2) + 1$$

$$50. g(x) = (x-2)^3 - 3(x-2)^2 + 1$$

FAMILIES OF GRAPHS

Sketch a graph of each of the following. *Show T-tables of values.*

1. $y = -x + 6$

2. $y = (x - 2)^3$

3. $y = \frac{4}{x+5} - 3$

4. $y = -\sqrt{x+9}$

5. $y = -2(x-5)^2 + 2$

6. $y = \sqrt[3]{x-1}$

7. $y = -\frac{1}{x^2} + 4$

8. $y = -3|x-2| + 6$

9. $y = [x+6]$

10. $y = \sqrt{4-x}$

11. $y = 8 - x^3$

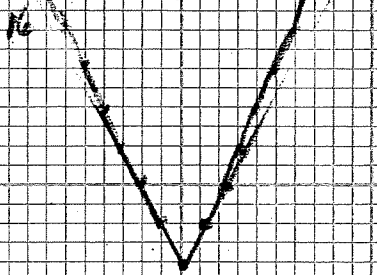
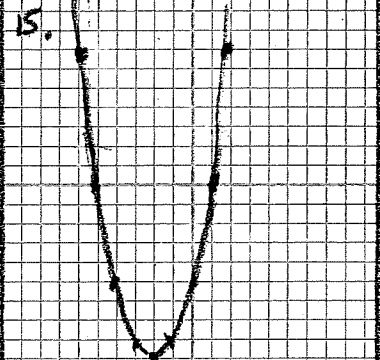
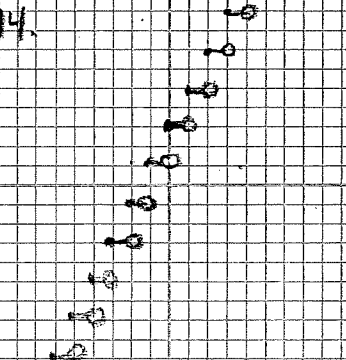
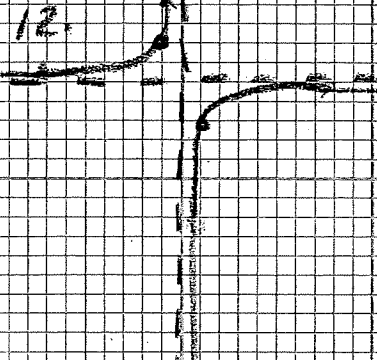
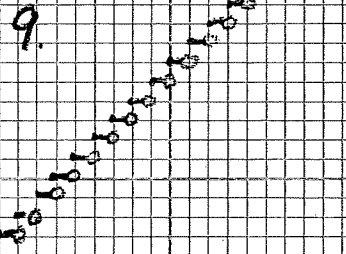
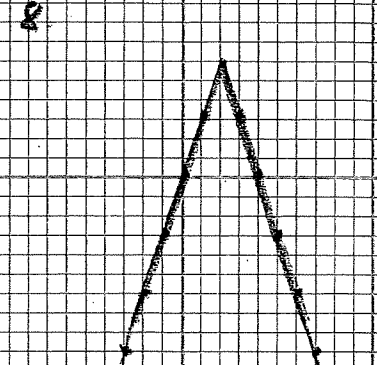
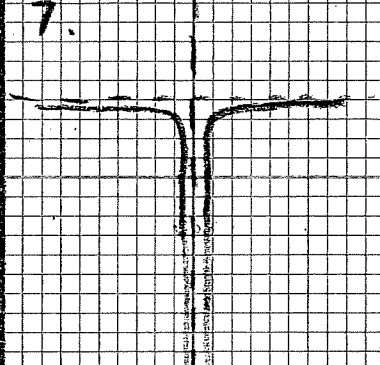
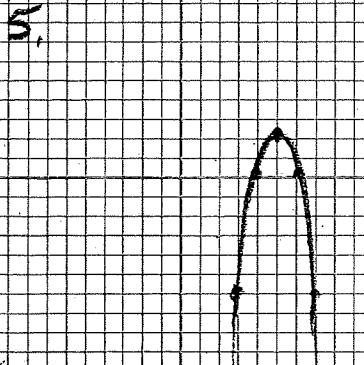
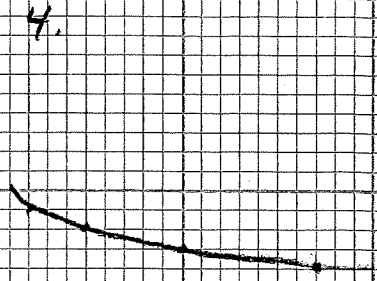
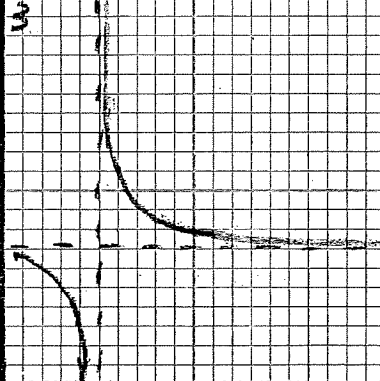
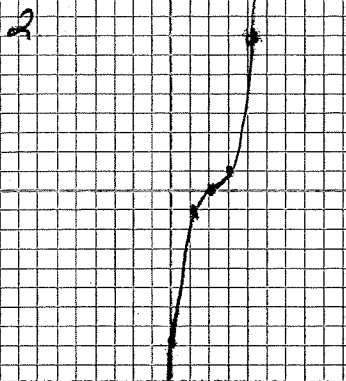
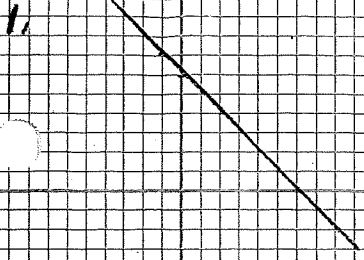
12. $y = \frac{-2}{x} + 5$

13. $y = 6 - \sqrt[3]{x}$

14. $y = 2[x] + 3$

15. $y = (x+2)^2 - 9$

16. $y = |2x| - 4$



PRECALCULUS HANDOUT

Determine the symmetry of the graphs of each of the following relations.

1. $x^2 - y = 0$

2. $xy^2 + 10 = 0$

3. $x - y^2 = 0$

4. $y = \sqrt{9 - x^2}$

5. $y = x^3$

6. $xy = 4$

7. $y = \frac{x}{x^2 + 1}$

8. $y = x^4 - x^2 + 3$

Determine whether each function is even, odd, or neither.

9. $f(x) = x^3 - x$

10. $f(x) = \frac{|3x|}{x^2 - 4}$

11. $h(x) = x^3 - 1$

12. $k(x) = \sqrt{1 - x}$

13. $m(x) = (x - 1)^2 + 2$

14. $n(x) = x^6 - 2x^2 + 3$

15. $p(x) = x\sqrt{1 - x^2}$

16. $q(x) = \frac{4 - x^2}{5x}$

ANSWERS

1. y-axis
2. x-axis
3. x-axis
4. y-axis
5. origin
6. origin
7. origin
8. y-axis
9. odd
10. even
11. neither
12. neither
13. neither
14. even
15. odd
16. odd

PRECALCULUS HANDOUT

Graph each of the following piecewise functions.

$$1. f(x) = \begin{cases} -\sqrt[3]{x+8} + 3 & x < 0 \\ \lfloor x+2 \rfloor & x \geq 0 \end{cases}$$

$$2. g(x) = \begin{cases} \frac{3}{x+2} + 3 & x < -2 \\ x^3 + 3 & -2 \leq x \leq 2 \end{cases}$$

$$3. h(x) = \begin{cases} -\sqrt{x+8} & -8 \leq x < -4 \\ -(x+1)^2 + 7 & -4 \leq x < 1 \\ 2|x-4| - 3 & 1 \leq x \leq 7 \end{cases}$$

$$4. k(x) = \begin{cases} -|x+3| + 5 & x < -2 \\ (x+2)^3 + 4 & -2 \leq x \leq 0 \\ -2x + 12 & x > 0 \end{cases}$$

$$5. p(x) = \begin{cases} -3|x+7| + 5 & x \leq -6 \\ \sqrt{-2-x} & -6 \leq x < -2 \\ -3 & -2 \leq x < 3 \\ 2(x-4)^2 - 1 & 3 \leq x \leq 6 \end{cases}$$

