Exercises

California Standards
7.0, 11.1, 15.0; Preview of Mathematical Analysis 6.0

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GUIDED PRACTICE

1. **Vocabulary** A function with a hole in its graph is __?__ . (*continuous* or *discontinuous*)

EXAMPLE 1
p. 592

Using the graph of $f(x) = \frac{1}{x}$ as a guide, describe the transformation and graph each function.

2. $g(x) = \frac{1}{x} - 2$

3. $g(x) = \frac{1}{x+5}$

4. $g(x) = \frac{1}{x-1} + 4$

EXAMPLE 2
p. 593

Identify the asymptotes, domain, and range of each function.

5. $f(x) = \frac{1}{x} - 1$

6. $f(x) = \frac{1}{x+4} + 3$

7. $f(x) = \frac{2}{x-2} - 8$

EXAMPLE 3
p. 594

Identify the zeros and vertical asymptotes of each function. Then graph.

8. $f(x) = \frac{x^2 - x - 12}{x}$

9. $f(x) = \frac{x^2 - 5x}{x-2}$

10. $f(x) = \frac{x^2}{x-1}$

EXAMPLE 4
p. 595

Identify the zeros and asymptotes of each function. Then graph.

11. $f(x) = \frac{x^2 + 3x + 2}{3 - x}$

12. $f(x) = \frac{x-2}{x^2 + 6x}$

13. $f(x) = \frac{5x+2}{x+1}$

EXAMPLE 5
p. 596

Identify holes in the graph of each function. Then graph.

14. $f(x) = \frac{x^2 - 5x + 6}{x^2 - 4x + 3}$

15. $f(x) = \frac{x^2 - 4x + 4}{x - 2}$

16. $f(x) = \frac{4x + 20}{2x + 10}$

PRACTICE AND PROBLEM SOLVING

Using the graph of $f(x) = \frac{1}{x}$ as a guide, describe the transformation and graph each function.

17. $g(x) = \frac{1}{x} - 5$

18. $g(x) = \frac{1}{x+3}$

19. $g(x) = \frac{2}{x}$

Identify the asymptotes, domain, and range of each function.

20. $f(x) = \frac{1}{x+6}$

21. $f(x) = \frac{4}{x} + 5$

22. $f(x) = \frac{3}{x-4} - 1$

Identify the zeros and vertical asymptotes of each function. Then graph.

23. $f(x) = \frac{(x+2)(x-5)}{(x-2)}$

24. $f(x) = \frac{(2-x)(4+x)}{(x-1)}$

25. $h(x) = \frac{x^2 - 4}{x+3}$

Identify the zeros and asymptotes of each function. Then graph.

26. $f(x) = \frac{x^2 - x - 2}{1 - x}$

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

28. $f(x) = \frac{2x^2 + x}{1 - x^2}$

Identify holes in the graph of each function. Then graph.

29. $f(x) = \frac{x^4}{x}$

30. $f(x) = \frac{-x^2 + x}{x - 1}$

31. $f(x) = \frac{x^2 - 14x + 49}{x - 7}$

32. **Band** Members of a high school band plan to play at a college bowl game. The trip will cost $350 per band member plus a $2000 deposit.

   a. Write a function to represent the total average cost of the trip per band member.

   b. Graph the function.

   c. **What if...?** Find the total average cost per person if 40 band members attend the bowl game.

Identify all zeros, asymptotes, and holes in the graph of each function.

33. $f(x) = \dfrac{x^2 - 2x - 3}{x^2 - 3x}$ **34.** $f(x) = \dfrac{x^3 - 1}{x - 1}$ **35.** $f(x) = \dfrac{6x - 5}{2 - 3x}$

36. $f(x) = \dfrac{x^2 + 6x + 8}{x^2}$ **37.** $f(x) = \dfrac{x}{x^2 - 9}$ **38.** $f(x) = \dfrac{x^2 - 9}{x^2 - 4}$

Write a rational function with the given characteristics.

39. zeros at -1 and 3 and vertical asymptote at $x = 0$

40. zero at 2, vertical asymptotes at $x = -2$ and $x = 0$, and horizontal asymptote at $y = 0$

41. zero at 2, vertical asymptote at $x = -1$, horizontal asymptote at $y = 1$, and hole at $x = -3$

42. Math History The *Agnesi curve* is the graph of the function $y = \dfrac{a^3}{x^2 + a^2}$.
  a. Graph the Agnesi curve for $a = 3$.
  b. What are the domain and the range of the function?
  c. Identify all asymptotes of the function.

43. Chemistry A chemist has 100 g of a 12% saline solution that she wants to strengthen to 25%. The percentage P of salt in the solution by mass can be modeled by $P(x) = \dfrac{100(12 + x)}{100 + x}$, where x is the number of grams of salt added.
  a. Graph the function for $0 \le x \le 100$.
  b. Use your graph to estimate how much salt the chemist must add to create a 25% solution.

44. Multi-Step The average cost per DVD purchased from a movie club is a function of the number of DVDs a member buys.
 **a.** Graph the data in the table.
  b. The function that describes the data in the table has the form $f(x) = \frac{40}{x} + k$, where k is a constant. What is the value of k?
  c. What is the total cost of buying 15 DVDs from the club?

Number of DVDs	Average Cost ($)
1	55
2	35
4	25
5	23
10	19
20	17

45. ///ERROR ANALYSIS/// A student wrote the following description for the graph of $f(x) = \dfrac{(x - 1)(2x - 3)}{(x + 1)(x - 1)}$. Explain the error. Write a correct description.
The graph has vertical asymptotes at $x = 1$ and $x = -1$ and a horizontal asymptote at $y = 2$.

46. Critical Thinking Is it possible to have a rational function with no vertical asymptotes? Explain.
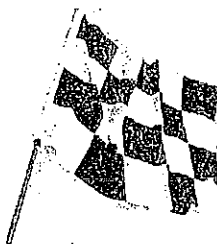
47. This problem will prepare you for the Concept Connection on page 608.
A race car driver makes a pit stop at the beginning of a lap. The time t in seconds that it takes the driver to complete the lap, including the pit stop, can be modeled by $t(r) = \dfrac{12r + 9000}{r}$, where r is the driver's average speed in miles per hour after the pit stop.
  a. Graph the function.
  b. What is the horizontal asymptote of the function, and what does it represent?
  c. The driver's average speed after the pit stop is 200 mi/h. How long does it take the driver to complete the lap, including the pit stop?