

4.2 Shift and Stretch

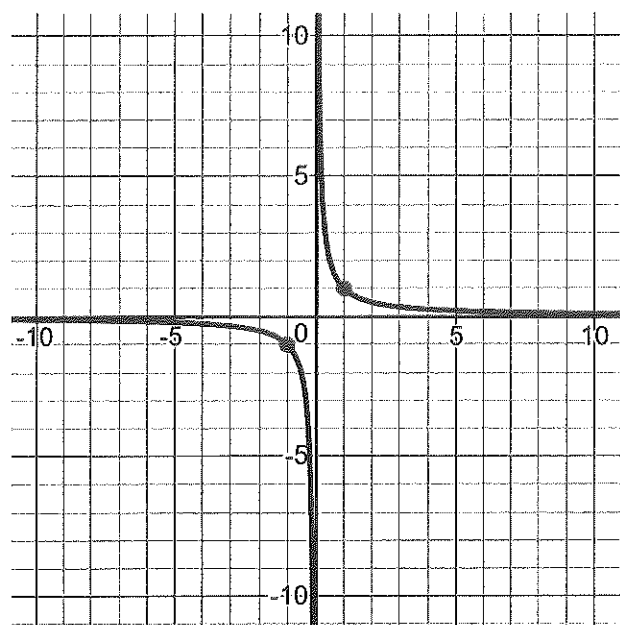
A Solidify Understanding Task



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In 4.1 *Winner, Winner* you were introduced to the function $y = \frac{1}{x}$. Before exploring the family of related functions, let's clarify some of the features of $y = \frac{1}{x}$ that can help with graphing.

Here's a graph of $y = \frac{1}{x}$.



1. Use the graph to identify each of the following:

Horizontal Asymptote: _____

Vertical Asymptote: _____

Anchor Points:

(1, _____) and (-1, _____)

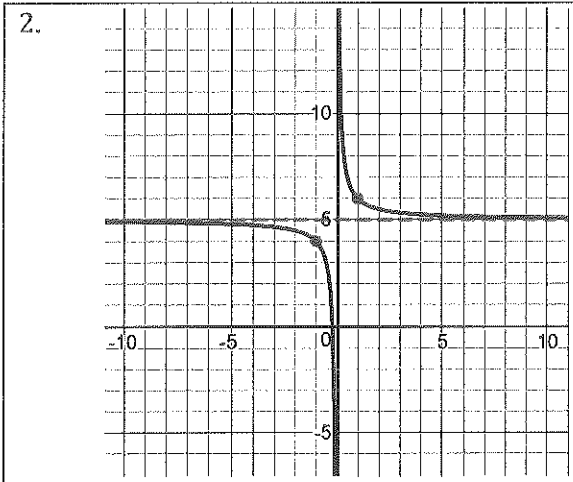
($\frac{1}{2}$, _____) and ($-\frac{1}{2}$, _____)

(2, _____) and (-2, _____)

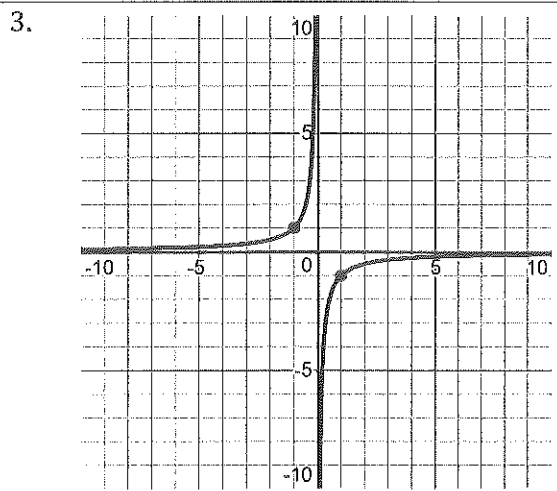
Now you're ready to use this information to figure out how the graph of $y = \frac{1}{x}$ can be transformed.

As you answer the questions that follow, look for patterns that you can generalize to describe the transformations of $y = \frac{1}{x}$.

In each of the following problems, you are given either a graph or a description of a function that is a transformation of $y = \frac{1}{x}$. Use your amazing math skills to find an equation for each.



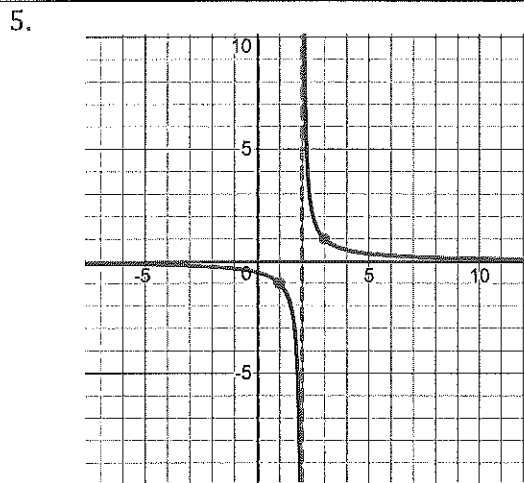
Equation:



Equation:

4. The function has a vertical asymptote at $x = -3$ and a horizontal asymptote at $y = 0$. It contains the points $(-2, 1)$ and $(-4, -1)$. The y-intercept is $(0, \frac{1}{3})$.

Equation:

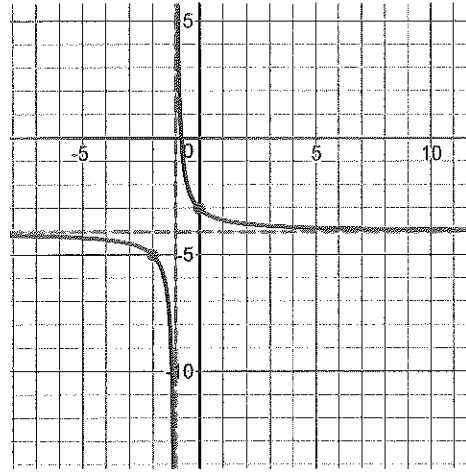


Equation:

6. The function has a vertical asymptote at $x = 0$ and a horizontal asymptote at $y = 0$. It contains the points $(1,2)$, $(-1, -2)$, $(2, 1)$, $(-2,1)$, $(\frac{1}{2}, 4)$ and $(-\frac{1}{2}, -4)$.

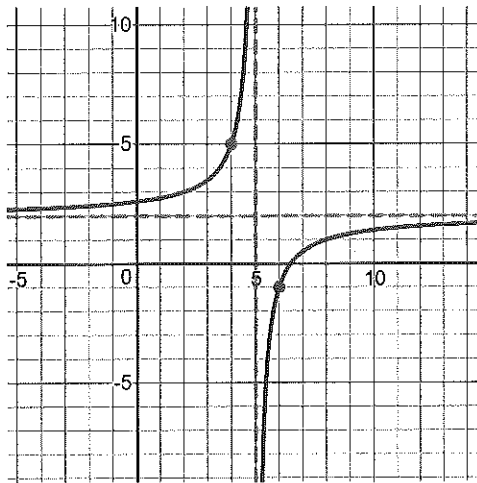
Equation:

7.



Equation:

8.



Equation:

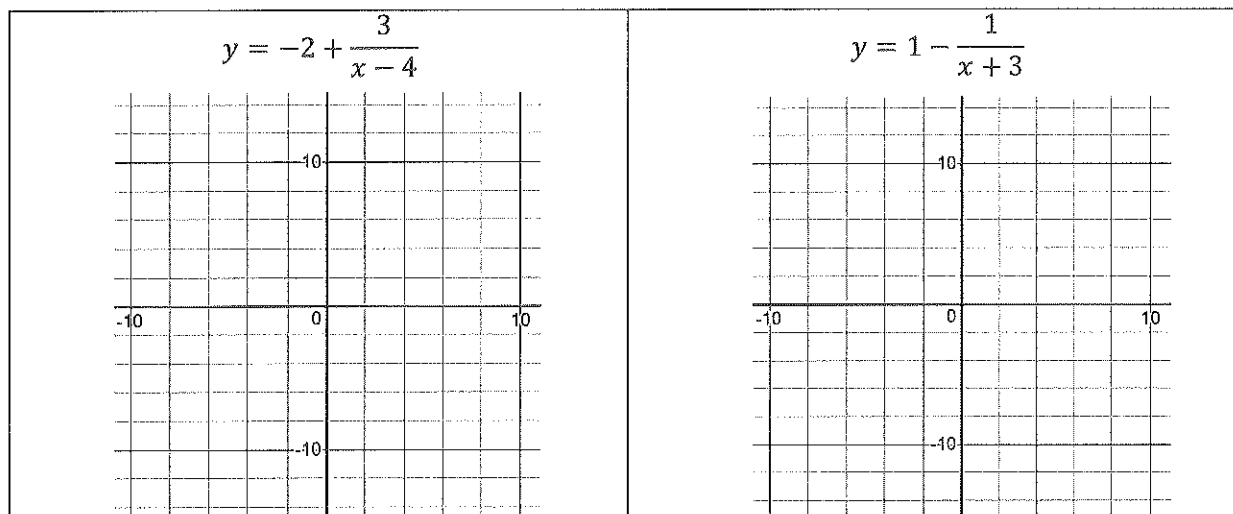
9. The function has a vertical asymptote at $x = -6$ and a horizontal asymptote at $y = -3$. It crosses the x-axis at $-6\frac{1}{3}$. It contains the points $(-5, -4)$ and $(-7, -2)$.

Equation:

10. Match each equation to the phrase that describes the transformation from $y = \frac{1}{x}$.

| | |
|-----------------------------|---|
| $y = \frac{1}{x+b}$ _____ | A) Reflection over the x -axis. |
| $y = b + \frac{1}{x}$ _____ | B) Vertical shift of b , making the horizontal asymptote $y = b$. |
| $y = \frac{b}{x}$ _____ | C) Horizontal shift left b , making the vertical asymptote $x = -b$. |
| $y = \frac{-1}{x}$ _____ | D) Vertical stretch by a factor of b |
| $y = \frac{1}{x-b}$ _____ | E) Horizontal shift right b , making the vertical asymptote $x = b$. |

11. Graph each of the following equations without using technology.



12. Describe the features of the function:

$$y = k + \frac{b}{x-h}$$

Vertical Asymptote:

Horizontal Asymptote:

Vertical Stretch Factor:

Anchor Points:

Domain:

Range:

READY, SET, GO!

Name

Period

Date

READY

Topic: Connecting the zeroes of a polynomial with the domain of a rational function

Find the zeroes of each polynomial.

1. $p(x) = (x + 4)(x - 2)(x - 7)$

2. $p(x) = (2x - 6)(8x - 1)(x - 5)$

3. $p(x) = (9x + 3)(x^2 - 9)$

4. $p(x) = x^2 + 25$

Find the domain of each of the rational functions.

5. $q(x) = \frac{1}{(x+4)(x-2)(x-7)}$

6. $q(x) = \frac{1}{(2x-6)(8x-1)(x-5)}$

7. $q(x) = \frac{1}{(9x+3)(x^2-9)}$

8. $q(x) = \frac{1}{x^2+25}$

SET

Topic: Practicing transformations on rational functions

Identify the vertical asymptote, horizontal asymptote, domain, and range of each function. Then sketch the graph on the grids provided. (Grids on next page.)

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

10. $f(x) = \frac{3}{x} + 2$

V.A.

H. A.

V.A.

H. A.

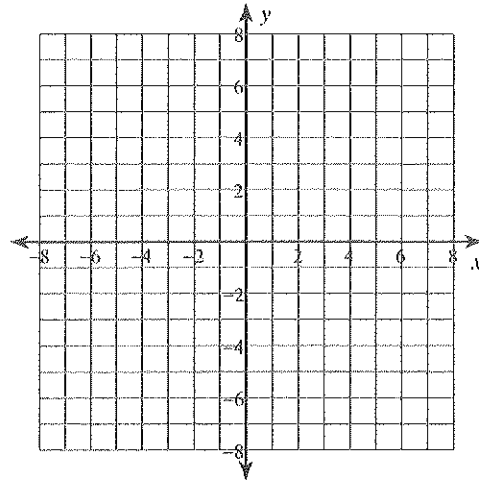
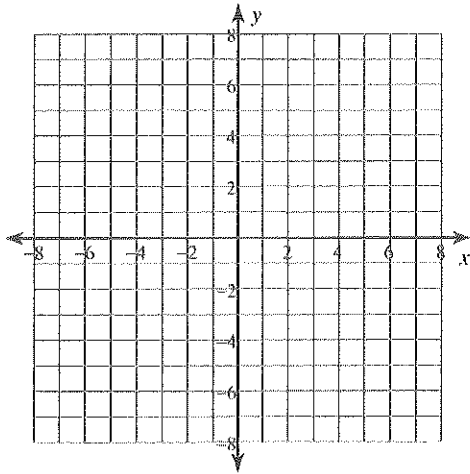
Domain:

Range:

Domain:

Range:

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11. $f(x) = -\frac{5}{x-3}$

V.A.

H. A.

Domain:

Range:

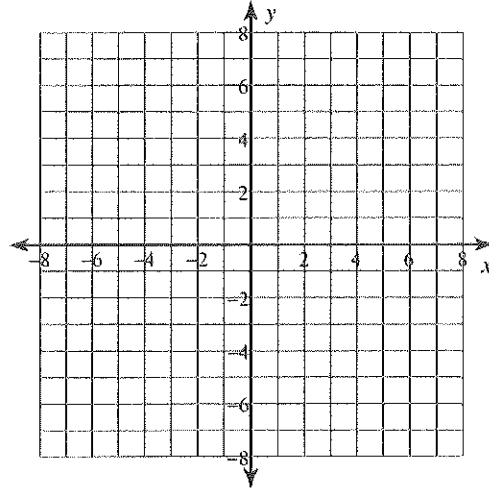
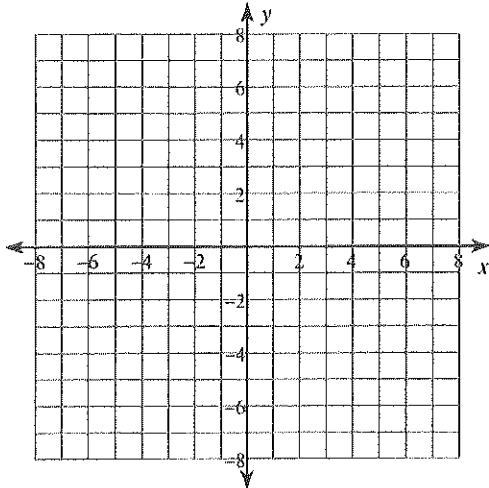
12. $f(x) = \frac{1}{(x+5)} - 4$

V.A.

H. A.

Domain:

Range:



13. Write a function of the form $f(x) = \frac{a}{x-h} + k$ with a vertical asymptote at $x = -15$ and a horizontal asymptote at $y = -6$.

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GO

Topic: Finding the roots and factors of a polynomial

Use the given root to find the remaining roots. Then write the function in factored form.

| | | | |
|--------------------------------------|----------|--|---------|
| 14. $f(x) = x^3 - x^2 - 17x - 15$ | $x = -1$ | 15. $f(x) = x^3 - 3x^2 - 61x + 63$ | $x = 1$ |
| 16. $f(x) = 6x^3 - 18x^2 - 60x$ | $x = 0$ | 17. $f(x) = x^3 - 14x^2 + 57x - 72$ | $x = 8$ |

18. A relationship exists between the roots of a function and the constant term of the function. Look back at the roots and the constant term in each problem. Make a statement about anything you notice.

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