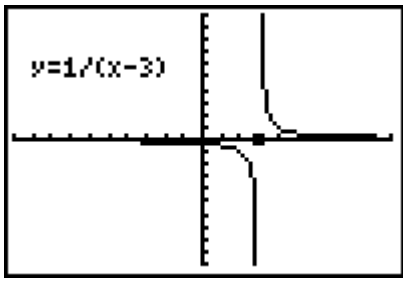
Problem 1 – Graphing $y = \frac{1}{x-a}$ for various values of *a*.

In this activity, you will explore the properties of functions of the form $y = \frac{1}{x-a}$ and identify vertical and horizontal asymptotes. The program **RATIONAL** allows you to look at graphs for different values of *a*. Select the program **RATIONAL** from the Program menu. Press ENTER to execute the program.

The program shows the graph of $y = \frac{1}{x-a}$. The value of *a* is shown by a dot on the *x*-axis at (*a*, 0). The starting value of *a* is 3. Press the ◄ and ► arrows to adjust the value of *a*. Notice that as the value of *a* changes, the equation and graph are updated. You can exit the program by pressing 9.



1. For what value of *x* is $y = \frac{1}{x-2}$ undefined?

2. For what value of *x* is $y = \frac{1}{x+1}$ undefined?

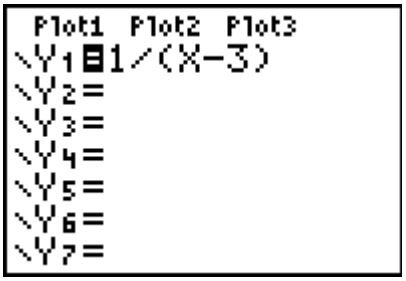
3. For what value of *x* is $y = \frac{1}{x-a}$ undefined?

4. As you move point *a* along the *x*-axis, the place where the graph of $y = \frac{1}{x-a}$ has a "break" follows along. Explain why this happens.

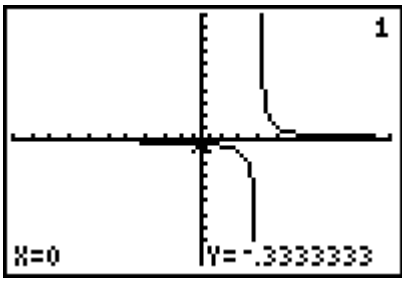
5. At what value of *x* does the graph of $y = \frac{1}{x-a}$ have a vertical asymptote?

Problem 2 – Behavior Near the Vertical Asymptote

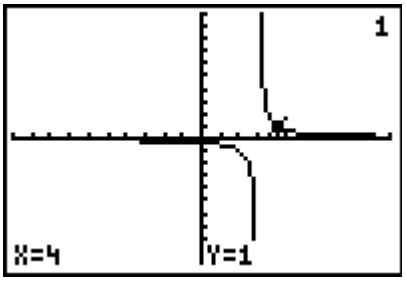
Graph the function $y = \frac{1}{x-3}$.



Press [TRACE] to place a point *P* on the graph.



Type **4** and press [ENTER]. The program moves the cursor to the point on the graph where $x = 4$ and displays the coordinates.



6. For each value of *x*, what is the *y*-coordinate of point *P*? Use the **Trace** feature to complete the table.

xval	yval
4	
3.5	
3.2	
2.8	
2.5	
2	

7. Enter 3.01 for *x*. Where did the point go? Adjust the window settings to bring point *P* into view. Record your settings here.

xmin: _____

xmax:_____

ymin:_____

ymax:_____

8. Now enter 2.99 for the *x*-coordinate of *P*. What is the value of *y*?

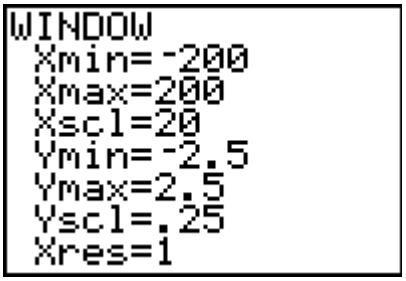
9. Could you make the *y*-coordinate of *P* be 1,000? If so, how?

10. Could you make the *y*-coordinate of point *P* be –1,000? If so, how?

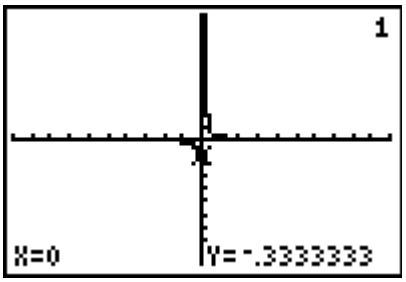
11. Could you make the *y*-coordinate of point *P* as big as anyone asked? How?

Problem 3 – Horizontal Asymptote

Adjust the window settings as shown.



Press [TRACE] to place a point *P* on the graph.



12. For each value of *x*, what is the *y*-coordinate of point *P*? Use the **Trace** feature to complete the table.

xval	yval
103	
13	
5	
1	
–7	
–97	

13. Enter 503 for *x*. Where did the point go? Adjust the window settings until the point is visible. Record your window settings here.

xmin: _____
xmax:_____
ymin:_____
ymax:_____

14. Now enter –497 for the *x*-coordinate of point *P*. What is the value of *y*? Adjust the window settings until you can see *P*. Record your window settings here.

xmin: _____
xmax:_____
ymin:_____
ymax:_____

15. Could you make the *y*-coordinate of point *P* be 0.001? If so, how?

16. Could you make the *y*-coordinate of point *P* be –0.001? If so, how?

17. Could you make the *y*-coordinate of point *P* as small as anyone asked? How?

18. At what value does the graph of $y = \frac{1}{x - a}$ have a horizontal asymptote?