

Using the ClassPad to Explore Limits

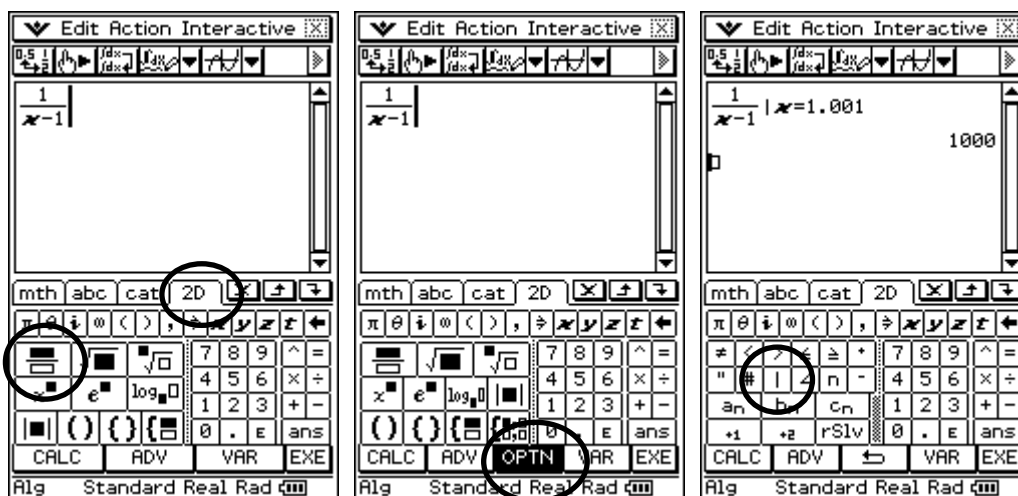
In this activity we will use the substitution key, limit function and a graph to better understand limits at points of interest.

Consider the following examples:

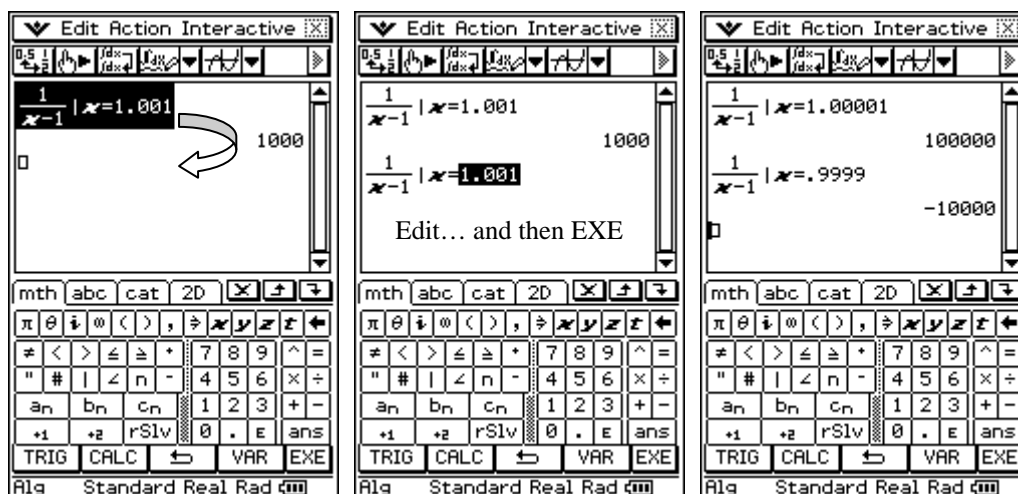
Evaluate $f(x) = \frac{1}{x-1}$ when $x = 1$	Each is undefined at $x=1$, but what is happening near $x=1$?
Evaluate $g(x) = \frac{1}{x^2-1}$ when $x = 1$	
Evaluate $h(x) = \frac{1}{(x-1)^2}$ when $x = 1$	
Evaluate $k(x) = \frac{x-1}{x^2-x}$ when $x = 1$	

We can use the ClassPad's substitution key to see what is happening close to $x=1$ as follows:

1. Tap M on the lower part of the window.
2. Select **Edit/Clear All**.
3. Open the soft keyboard (Press the k button).
4. Using the 2D math tab, input $\frac{1}{x-1}$ and press the right arrow to get out of the denominator.
5. Tap the lower OPTN button to find the | key.
6. Input | **x=1.001** following $\frac{1}{x-1}$ and press **EXE**.



7. Next, select the input and drag it to the next line. What happens for values less than 1?
8. Experiment with the x-values in line one and two by editing the value and pressing EXE again.

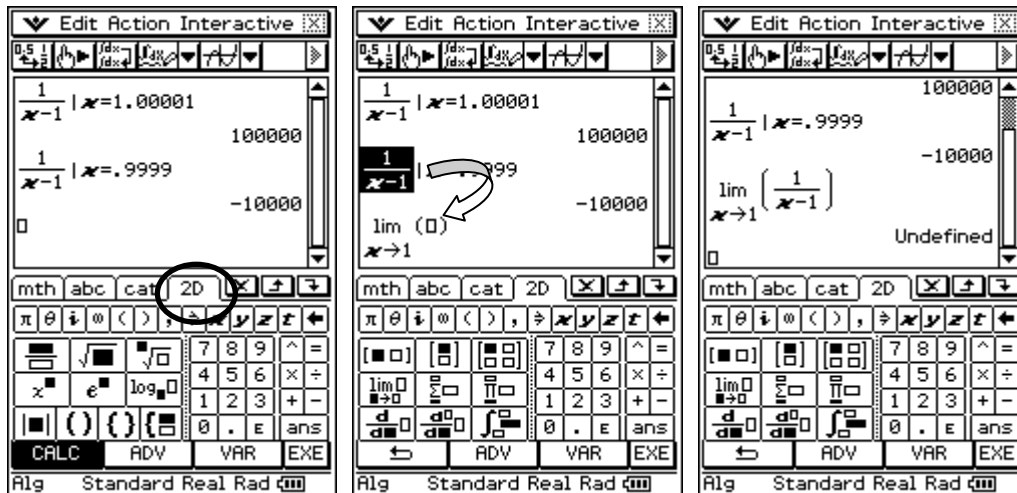


Question: Do you notice a pattern? Discuss with your partner what is happening as you input values greater than 1 and less than 1.

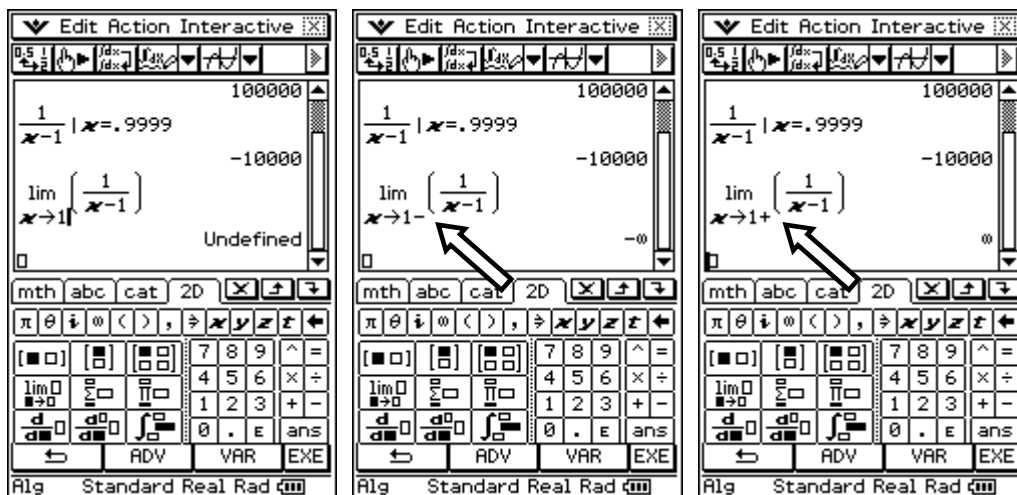
Next, we will use the ClassPad's limit function to evaluate the limit of $f(x)$ as x approaches 1.

1. Using the 2D math tab, tap CALC.

2. Tap the symbol for limit and fill in the boxes. Use drag and drop when possible!



3. Experiment with the limit from left and right by editing the limit to contain + and then -.

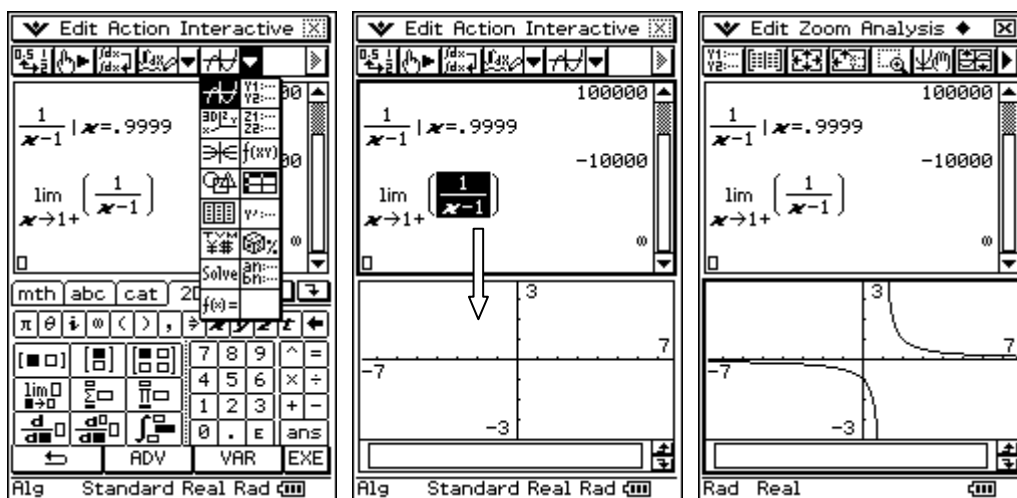


Complete: The limit of $f(x) = \frac{1}{x-1}$ as x approaches 1 from the right is: _____

The limit of $f(x) = \frac{1}{x-1}$ as x approaches 1 from the left is: _____

The limit of $f(x) = \frac{1}{x-1}$ as x approaches 1 is: _____

Do these results make sense? Can you visualize these results graphically? Let's graph it!




Complete:

In conclusion, the limit of $f(x) = \frac{1}{x-1}$ as x approaches 1 does not exist because the limit from the _____ does not equal the limit from the _____.

Exercise 1

Explore the limit of $g(x) = \frac{1}{x^2-1}$ as x approaches 1 by editing your input of $\frac{1}{x-1}$ to be $\frac{1}{x^2-1}$.

Hint: Use the  toolbar button to re-execute one line at a time (great feature).

- a. Evaluate $g(x) = \frac{1}{x^2-1}$ at values slightly greater than and slightly less than $x=1$.

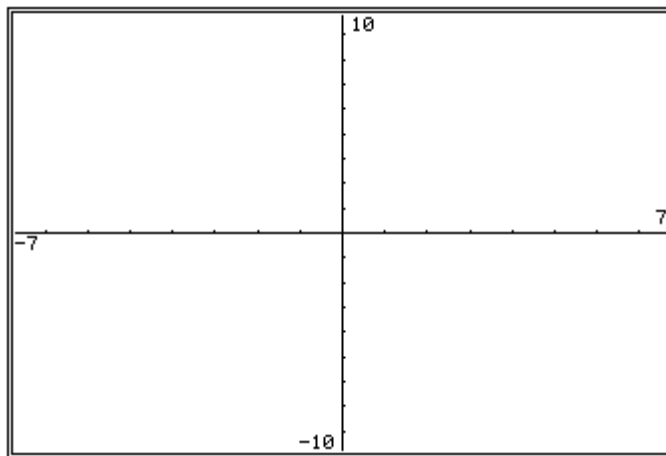
Discuss any patterns you notice with your partner.

- b. Complete: The limit of $g(x) = \frac{1}{x^2-1}$ as x approaches 1 from the right is:

The limit of $g(x) = \frac{1}{x^2-1}$ as x approaches 1 from the left is: _____

The limit of $g(x) = \frac{1}{x^2-1}$ as x approaches 1 is: _____

- c. Sketch the graph of $g(x) = \frac{1}{x^2 - 1}$:



- d. Write a concluding statement about the limit of $g(x) = \frac{1}{x^2 - 1}$ as x approaches 1. Be sure to include comments about the limit from the left and right.

Exercise 2

Explore the limit of $h(x) = \frac{1}{(x-1)^2}$ as x approaches 1 by editing $\frac{1}{x^2 - 1}$ to be $\frac{1}{(x-1)^2}$.

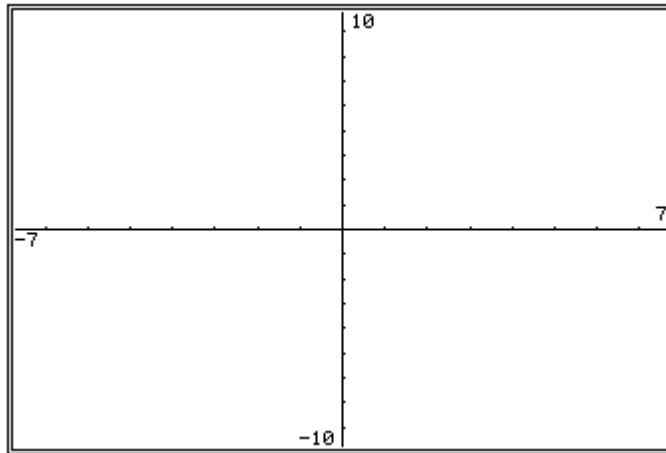
- a. Evaluate $h(x) = \frac{1}{(x-1)^2}$ at values slightly greater than and slightly less than $x=1$. Discuss any patterns you notice with your partner.

- b. Complete: The limit of $h(x) = \frac{1}{(x-1)^2}$ as x approaches 1 from the right is:

The limit of $h(x) = \frac{1}{(x-1)^2}$ as x approaches 1 from the left is:

The limit of $h(x) = \frac{1}{(x-1)^2}$ as x approaches 1 is: _____

- c. Using the ClassPad graph $h(x) = \frac{1}{(x-1)^2}$ and then sketch its graph below.



- d. Write a concluding statement about the limit of $h(x) = \frac{1}{(x-1)^2}$ as x approaches 1.
Be sure to include comments about the limit from the left and right.

Exercise 3

Explore the limit of $k(x) = \frac{x-1}{x^2-x}$ as x approaches 1 by editing $\frac{1}{(x-1)^2}$ to be $\frac{x-1}{x^2-x}$.

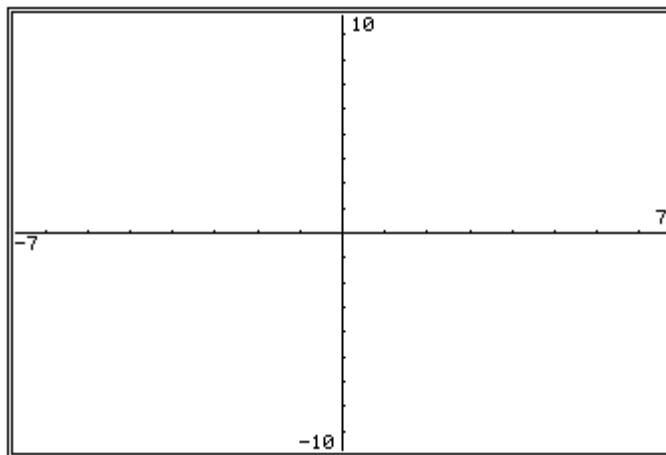
- a. Evaluate $k(x) = \frac{x-1}{x^2-x}$ at values slightly greater than and slightly less than $x=1$.
Discuss any patterns you notice with your partner.

- b. Complete: The limit of $k(x) = \frac{x-1}{x^2-x}$ as x approaches 1 from the right is:

The limit of $k(x) = \frac{x-1}{x^2-x}$ as x approaches 1 from the left is: _____

The limit of $k(x) = \frac{x-1}{x^2-x}$ as x approaches 1 is: _____

- c. Using the ClassPad graph $k(x) = \frac{x-1}{x^2-x}$ and then sketch its graph below. Hint:
Look carefully!



- d. Write a concluding statement about the limit of $k(x) = \frac{x-1}{x^2-x}$ as x approaches 1.
Be sure to include comments about the limit from the left and right.