



# Graphing Calculator Investigation

A Preview of Lesson 11-4

TI-73

## Limits

You may have noticed that in some geometric sequences, the later the term in the sequence, the closer the value is to 0. Another way to describe this is that as  $n$  increases,  $a_n$  approaches 0. The value that the terms of a sequence approach, in this case 0, is called the **limit** of the sequence. Other types of infinite sequences may also have limits. If the terms of a sequence do not approach a unique value, we say that the limit of the sequence does not exist.

Find the limit of the geometric sequence  $1, \frac{1}{3}, \frac{1}{9}, \dots$ .

### Step 1 Enter the sequence.

- The formula for this sequence is  $a_n = \left(\frac{1}{3}\right)^{n-1}$ .
- Position the cursor on L1 in the LIST screen and enter the formula  $\text{seq}(N,N,1,10,1)$ . This generates the values 1, 2, ..., 10 of the index  $N$ .

**KEYSTROKES:**  $\boxed{2\text{nd}} \boxed{[\text{STAT}]} \boxed{\blacktriangleright} \boxed{7} \boxed{2\text{nd}} \boxed{[\text{TEXT}]}$

Use the arrow and  $\boxed{\text{ENTER}}$  keys to highlight  $N$   $\boxed{,}$   $N$ .

$\boxed{\text{ENTER}} \boxed{,} \boxed{1} \boxed{,} \boxed{10} \boxed{,} \boxed{1} \boxed{)} \boxed{\text{ENTER}}$

- Position the cursor on L2 and enter the formula  $\text{seq}((1/3)^{(N-1)},N,1,10,1)$ . This generates the first ten terms of the sequence.

L1	L2	L3	Z
1	1		
2	.33333		
3	.11111		
4	.03704		
5	.01235		
6	.00412		
7	.00137		
8			
9			
10			

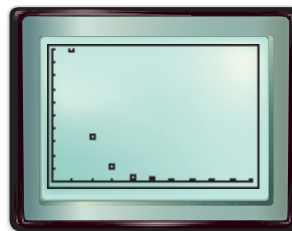
L2(1)=1

Notice that as  $n$  increases, the terms of the given sequence get closer and closer to 0. If you scroll down, you can see that for  $n \geq 8$  the terms are so close to 0 that the calculator expresses them in scientific notation. This suggests that the limit of the sequence is 0.

### Step 2 Graph the sequence.

- Use a PLOT to graph the sequence. Use L1 as the Xlist and L2 as the Ylist.

**KEYSTROKES:** Review PLOTs on page 87.



$[0, 10]$  scl: 1 by  $[0, 1]$  scl: 0.1

The graph also shows that, as  $n$  increases, the terms approach 0. In fact, for  $n \geq 6$ , the marks appear to lie on the horizontal axis. This strongly suggests that the limit of the sequence is 0.

**Exercises** Use a graphing calculator to find the limit, if it exists, of each sequence.

1.  $a_n = \left(\frac{1}{2}\right)^n$  **0**

2.  $a_n = \left(-\frac{1}{2}\right)^n$  **0**

3.  $a_n = 4^n$  **does not exist**

4.  $a_n = \frac{1}{n^2}$  **0**

5.  $a_n = \frac{2^n}{2^n + 1}$  **1**

6.  $a_n = \frac{n^2}{n + 1}$  **does not exist**



[www.algebra2.com/other\\_calculator\\_keystrokes](http://www.algebra2.com/other_calculator_keystrokes)