Linear
x graph to a line
x exponent 1

Nonlinear
could be curved
x exponent Not 1 x^2, x^3 $\frac{1}{x}$

Lesson 8: Graphs of Simple Nonlinear Functions

constant rate of change

Not constant.

Classwork

Exercises

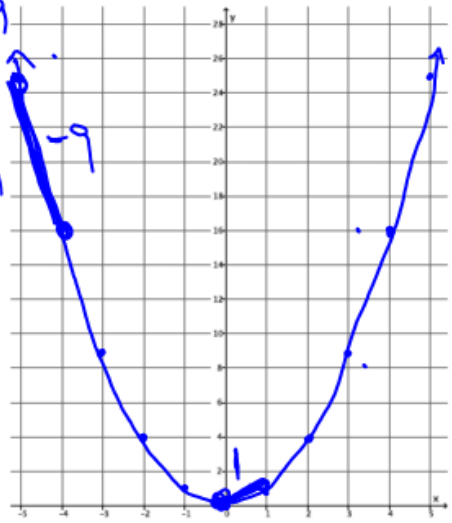
1. A function has the rule so that each input of x is assigned an output of x^2.
   a. Do you think the function is linear or nonlinear? Explain.

Nonlinear, the x exponent is not 1.

   b. Develop a list of inputs and outputs for this function. Organize your work using the table below. Then, answer the questions that follow.

Input (x)	Output (x^2)
−5	25
−4	16
−3	9
−2	4
−1	1
0	0
1	1
2	4
3	9
4	16
5	25

+1 −9 +1 +1



   c. Plot the inputs and outputs as points on the coordinate plane where the output is the y-coordinate.

d. What shape does the graph of the points appear to take?

It appears to make a parabola

e. Find the rate of change using rows 1 and 2 from the table above.

$\frac{25-16}{-5-(-4)} = \frac{9}{-1} = -9$

f. Find the rate of change using rows 2 and 3 from the above table.

$\frac{0-1}{0-1} = \frac{-1}{-1} = 1$

g. Find the rate of change using any two other rows from the above table.

h. Return to your initial claim about the function. Is it linear or nonlinear? Justify your answer with as many pieces of evidence as possible.

2. A function has the rule so that each input of x is assigned an output of $2x-1$

a. Do you think the function is linear or nonlinear? Explain.

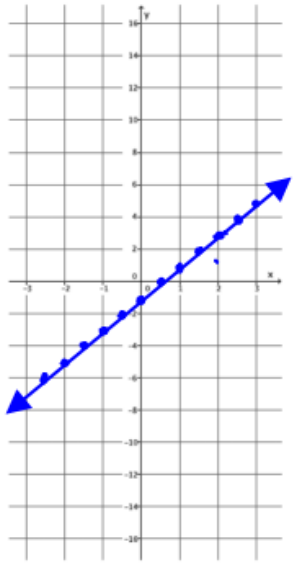
Linear, the x exponent is 1.

b. Develop a list of inputs and outputs for this function. Organize your work using the table below. Then, answer the questions that follow.

$2x-1$

Input (x)	Output (y)
−2.5	-6
−2	-5
−1.5	-4
−1	-3
−0.5	-2
0	-1
0.5	0
1	1
1.5	2
2	3
2.5	4

+0.5 +0.5 +1 +1 +2 +4



c. Plot the inputs and outputs as points on the coordinate plane where the output is the y-coordinate.

d. What shape does the graph of the points appear to take?

It appears to be a straight line

e. Find the rate of change using rows 2 and 3 from the table above.

$$\frac{\Delta y}{\Delta x} = \frac{1}{0.5} = 2$$

$$\frac{\Delta y}{\Delta x} = \frac{4}{2} = 2$$

f. Find the rate of change using rows 3 and 4 from the table above.

$$\frac{\Delta y}{\Delta x} = \frac{1}{0.5} = 2$$

5. What shape do you expect the graph of the function described by $y = 2x^2 - x$ to take? Is it a linear or nonlinear function?

curve

6. What shape do you expect the graph of the function described by $3x + 7y = 8$ to take? Is it a linear or nonlinear function?

line

7. What shape do you expect the graph of the function described by $y = 4x^3$ to take? Is it a linear or nonlinear function?

Curve

8. What shape do you expect the graph of the function described by $\frac{3}{x} = y$ to take? Is it a linear or nonlinear function?

Curve

9. What shape do you expect the graph of the function described by $\frac{4}{x^2} = y$ to take? Is it a linear or nonlinear function?

Curve

10. What shape do you expect the graph of the equation $x^2 + y^2 = 36$ to take? Is it a linear or nonlinear? Is it a function? Explain.

Curve

Lesson Summary

One way to determine if a function is linear or nonlinear is by inspecting the rate of change using a table of values. Another way is to examine its graph. Functions described by nonlinear equations do not have a constant rate of change. Because some functions can be described by equations, an examination of the equation allows you to determine if the function is linear or nonlinear. Just like with equations, when the exponent of the variable x is not equal to 1, then the equation is nonlinear; therefore, the graph of the function described by a nonlinear equation will graph as some kind of curve, i.e., not a line.

Problem Set

1. A function has the rule so that each input of x is assigned an output of $x^2 - 4$.

   a. Do you think the function is linear or nonlinear? Explain.

   b. What shape do you expect the graph of the function to be?

   c. Develop a list of inputs and outputs for this function. Plot the inputs and outputs as points on the coordinate plane where the output is the y-coordinate.

   d. Was your prediction correct?

Use rate of change to explain!

Input (x)	Output ($x^2 - 4$)
-3	
-2	
-1	
0	
1	
2	
3	

2. A function has the rule so that each input of x is assigned an output of $x+3$

   a. Is the function linear or nonlinear? Explain.

   b. What shape do you expect the graph of the function to take?

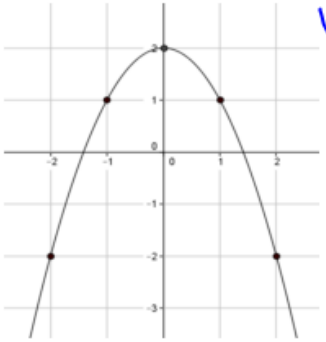
   c. Given the inputs in the table below, use the rule of the function to determine the corresponding outputs. Plot the inputs and outputs as points on the coordinate plane where the output is the y-coordinate.

   d. Was your prediction correct?

Use rate of change to explain!

Input (x)	Output ($x+3$)
-2	
-1	
0	
1	
2	
3	

3. Is the function that is represented by this graph linear or nonlinear? Explain. Show work that supports your claim.



Use rate of change!