Function Detective

Sort rules by how their outputs change.

8.AF.D.15.a "Distinguish between linear and non-linear functions."

NAME _____ DATE _____

LINEAR

For equal steps in the input, the output changes by the same amount. Its graph is a straight line.

A bike rental costs $6 to start and $4 per hour. The total cost is $C = 6 + 4h$, where h is the number of hours.

NONLINEAR

For equal steps in the input, the output does not always change by the same amount. Its graph is not a straight line.

A square garden with side length s has area $A = s^2$.

1 SORT

8 items

In Part 1, circle LINEAR or NONLINEAR for each rule, then in Part 2 choose two numbered rules, one from each category, and explain how you know.

1. $y = 2x + 7$ — LINEAR / NONLINEAR

2. $y = -4x + 1$ — LINEAR / NONLINEAR

3. $y = 3x^2 - 5$ — LINEAR / NONLINEAR

4. $y = 9 - x/2$ — LINEAR / NONLINEAR

5. $y = 2^x + 1$ — LINEAR / NONLINEAR

6. $y = |x| + 3$ — LINEAR / NONLINEAR

7. $y = 5(x - 2)$ — LINEAR / NONLINEAR

8. $y = (x + 4)/2$ — LINEAR / NONLINEAR

2 PROVE IT

Explain your thinking

Choose two numbered rules, one from each category, and explain how you know.

ITEM # _____ **HOW I KNEW** _____

ITEM # _____ **HOW I KNEW** _____

3 MAKE YOUR OWN

One of each

In Part 3, write one new LINEAR rule and one new NONLINEAR rule, using x as the input and y as the output.

LINEAR

NONLINEAR

CHALLENGE

Write a nonlinear rule that gives outputs of 0, 1, and 4 when x is 0, 1, and 2; explain why your rule is nonlinear.

ANSWER KEY # Function Detective

PART 1 · SORT

#	ITEM	CATEGORY	WHY
1	$y = 2x + 7$	**LINEAR**	Each increase of 1 in x increases y by 2.
2	$y = -4x + 1$	**LINEAR**	Each increase of 1 in x decreases y by 4.
3	$y = 3x^2 - 5$	**NONLINEAR**	The output changes by different amounts for equal steps in x.
4	$y = 9 - x/2$	**LINEAR**	Each increase of 1 in x decreases y by 1/2.
5	$y = 2^x + 1$	**NONLINEAR**	The output doubles before 1 is added, so equal steps in x do not give a constant change in y.
6	$y = \|x\| + 3$	**NONLINEAR**	The rate of change differs on either side of $x = 0$.
7	$y = 5(x - 2)$	**LINEAR**	It simplifies to $y = 5x - 10$.
8	$y = (x + 4)/2$	**LINEAR**	It simplifies to $y = x/2 + 2$.

PART 2 · PROVE IT

Task: Choose two numbered rules, one from each category, and explain how you know.
Accept any explanation that names the deciding feature from the rule box for the chosen item.

PART 3 · MAKE YOUR OWN (SAMPLE ANSWERS)

- **LINEAR**: $y = -3x + 8$
- **NONLINEAR**: $y = x^2 + 3x + 1$

Challenge: $y = x^2$ gives outputs of 0, 1, and 4. For equal steps in x, the outputs change by 1 and then 3, so the rule is nonlinear.

For Part 2, students should explain one linear and one nonlinear item using constant or nonconstant output changes for equal input steps. Accept equivalent explanations based on a straight or non-straight graph.