Linear vs. Nonlinear Functions

Explore ideas and representations

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

A linear function has a constant rate of change and can be written $y = mx + b$. In a table, compare $\Delta y/\Delta x$, not just Δy. The rule $y = x^2$ gives changes $1, 3, 5$ at consecutive nonnegative integer inputs, so it is nonlinear. A horizontal rule such as $y = 4$ is linear with slope 0.

Worked example

Example for form 1: classify using rates.

x	y
0	1
1	3
2	5

1. Compute each consecutive slope, including the input gaps: $(3-(1))/(1-(0)) = 2$, $(5-(3))/(2-(1)) = 2$.
2. All slopes equal 2; the points lie on one line. Equal output changes alone are insufficient unless the input gaps are equal.
Answer: Linear.

Practice Problems

Show your thinking.

1. Classify the constant-increment table.

x	y
0	2
1	5
2	8
3	11

2. Classify the square-output table.

x	y
0	0
1	1
2	4
3	9

3. Classify the decreasing table.

x	y
-1	8
0	6
1	4
2	2

4. Classify this table of repeated outputs.

x	y
0	5
2	5
4	5
6	5

5. Test the table with increasing jumps.

x	y
1	2
2	4
3	8
4	16

6. Classify the rule. $y = 4x - 7$

7. Test this squared-input rule. $y = x^2 + 2$

8. Classify a horizontal function. $y = 6$

9. Check input gaps before classifying.

x	y
0	1
2	5
5	11

10. Classify a rule with a fractional slope. $y = \frac{1}{2}x + 1$

Answer Key

1. Linear.
2. Nonlinear.
3. Linear.
4. Linear.
5. Nonlinear.
6. Linear.
7. Nonlinear.
8. Linear.
9. Linear.
10. Linear.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Compute each consecutive slope, including the input gaps: $(5-(2))/(1-(0))=3$, $(8-(5))/(2-(1))=3$, $(11-(8))/(3-(2))=3$.

2. All slopes equal 3; the points lie on one line. Equal output changes alone are insufficient unless the input gaps are equal.

Problem 2

1. Compute each consecutive slope, including the input gaps: $(1-(0))/(1-(0))=1$, $(4-(1))/(2-(1))=3$, $(9-(4))/(3-(2))=5$.

2. These slopes are not all equal, so one straight line cannot contain all the points. Equal output changes alone are insufficient unless the input gaps are equal.

Problem 3

1. Compute each consecutive slope, including the input gaps: $(6-(8))/(0-(-1))=-2$, $(4-(6))/(1-(0))=-2$, $(2-(4))/(2-(1))=-2$.

2. All slopes equal -2; the points lie on one line. Equal output changes alone are insufficient unless the input gaps are equal.

Problem 4

1. Compute each consecutive slope, including the input gaps: $(5-(5))/(2-(0))=0$, $(5-(5))/(4-(2))=0$, $(5-(5))/(6-(4))=0$.

2. All slopes equal 0; the points lie on one line. Equal output changes alone are insufficient unless the input gaps are equal.

Problem 5

1. Compute each consecutive slope, including the input gaps: $(4-(2))/(2-(1))=2$, $(8-(4))/(3-(2))=4$, $(16-(8))/(4-(3))=8$.

2. These slopes are not all equal, so one straight line cannot contain all the points. Equal output changes alone are insufficient unless the input gaps are equal.

Problem 6

1. For inputs $0, 1, 2$, the outputs are $-7, -3, 1$. The consecutive changes are 4 and 4.

2. The expression is $mx+b$ with $m=4$, $b=-7$. Its rate is always 4, so it is linear for all real inputs.

Problem 7

1. For inputs $0, 1, 2$, the outputs are $2, 3, 6$. The consecutive changes are 1 and 3.

2. The rates 1 and 3 differ across equal input gaps. Those three points are not collinear, so the function is nonlinear.

Problem 8

1. For inputs $0, 1, 2$, the outputs are $6, 6, 6$. The consecutive changes are 0 and 0.

2. Write the rule as $y=0x+6$. Its rate is constantly 0, and its graph is a horizontal line; therefore it is linear.

Problem 9

1. Compute each consecutive slope, including the input gaps: $(5-(1))/(2-(0))=2$, $(11-(5))/(5-(2))=2$.

2. All slopes equal 2; the points lie on one line. Equal output changes alone are insufficient unless the input gaps are equal.

Problem 10

1. For inputs $0, 1, 2$, the outputs are $1, 3/2, 2$. The consecutive changes are $1/2$ and $1/2$.

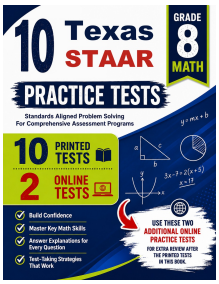
2. The rule already has form $mx+b$, with $m=\frac{1}{2}$ and $b=1$. Its constant rate makes the function linear.

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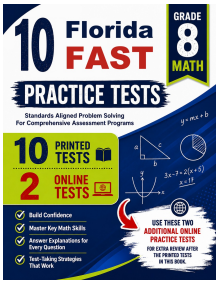
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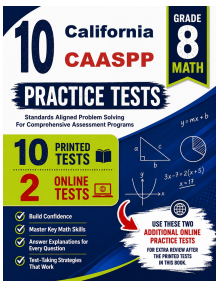
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