Linear vs. Nonlinear Functions

Spot mistakes, reason, and work backward

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

QUICK REVIEW

Unequal input gaps require division: points $(0,1),(2,5),(5,11)$ have slopes $4/2=2$ and $6/3=2$. Unequal output changes therefore can still describe a line. Conversely, equal output changes over unequal input gaps need not. Simplify a rule before classifying; for example, $x^2-x^2+3x=3x$ is linear.

Worked example

Example for form 2: classify using rates.

x	y
0	2
1	4
2	6

1. Compute each consecutive slope, including the input gaps: $(4-(2))/(1-(0))=2$, $(6-(4))/(2-(1))=2$.
2. All slopes equal 2; the points lie on one line. Equal output changes alone are insufficient unless the input gaps are equal.
Answer: Linear.

Practice Problems

Show your thinking.

1. A learner rejects this because output jumps differ. Correct the classification.

x	y
0	3
2	7
5	13

2. A learner sees output jumps of 6 and calls this linear. Check the input gaps.

x	y
0	1
1	7
3	13

3. A learner says a decreasing function cannot be linear. Test this.

x	y
0	12
2	6
4	0

4. Check whether two equal early jumps prove the whole table linear.

x	y
0	1
1	4
2	7
3	12

5. Fill k so $(0,2),(2,8),(4,k)$ lie on a line.

6. A table has $(1,5),(3,9),(6,15)$. A student divides all output changes by 2. Correct the rates.

7. Simplify before deciding. $y=x^2-x^2+3x+1$

8. A learner calls every formula with x linear. Test this counterexample. $y=2^x$

9. Is a straight vertical line $x=3$ a linear function of x? Explain using two points.

10. Correct only the last output in $(0,4),(1,7),(2,10),(3,15)$ to make a linear table.

Answer Key

1. Linear.
2. Nonlinear.
3. Linear.
4. Nonlinear.
5. $k = 14$
6. Both rates are 2; linear.
7. Linear.
8. Nonlinear.
9. No; it is not a function of x.
10. Replace 15 with 13.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Compute each consecutive slope, including the input gaps: $(7-(3))/(2-(0)) = 2$, $(13-(7))/(5-(2)) = 2$.

2. All slopes equal 2; the points lie on one line. This corrects the stated claim.

Problem 2

1. Compute each consecutive slope, including the input gaps: $(7-(1))/(1-(0)) = 6$, $(13-(7))/(3-(1)) = 3$.

2. These slopes are not all equal, so one straight line cannot contain all the points. This corrects the stated claim.

Problem 3

1. Compute each consecutive slope, including the input gaps: $(6-(12))/(2-(0)) = -3$, $(0-(6))/(4-(2)) = -3$.

2. All slopes equal -3; the points lie on one line. This corrects the stated claim.

Problem 4

1. Compute each consecutive slope, including the input gaps: $(4-(1))/(1-(0)) = 3$, $(7-(4))/(2-(1)) = 3$, $(12-(7))/(3-(2)) = 5$.

2. These slopes are not all equal, so one straight line cannot contain all the points. This corrects the stated claim.

Problem 5

1. The first slope is $(8-2)/(2-0) = 6/2 = 3$. The next input also increases by 2, so the next output must increase by $3(2) = 6$.

2. Thus $k = 8+6 = 14$. Check the second slope: $(14-8)/(4-2) = 6/2 = 3$, which matches the first slope.

Problem 6

1. The first input gap is $3-1 = 2$, giving $(9-5)/2 = 2$. The second gap is $6-3 = 3$, not 2.

2. The second rate is $(15-9)/3 = 6/3 = 2$. The matching rates show these points lie on a line.

Problem 7

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

2. The square terms cancel: $x^2 - x^2 = 0$, leaving $y = 3x + 1$. The constant rate is 3, so the simplified function is linear.

Problem 8

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

2. The changes 1 and 2 differ over equal input steps. Exponential doubling is not a constant additive rate, so this function is nonlinear.

Problem 9

1. The vertical line contains both $(3, 0)$ and $(3, 2)$, since each point has $x = 3$. These give outputs $0 \neq 2$ for the same input.

2. A function of x cannot have those two outputs at input 3. Thus this straight line is not a linear function of x.

Problem 10

1. The first two output changes are $7-4 = 3$ and $10-7 = 3$, each for an input increase of 1.

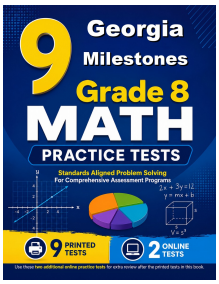
2. Continue that rate: $10+3 = 13$. Replacing the final output by 13 gives the linear rule $y = 3x + 4$ for all four rows.

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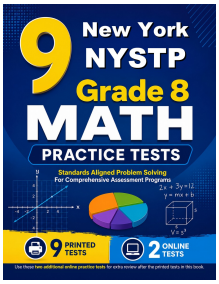
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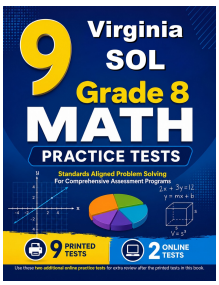
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