Building Linear Functions

Spot mistakes, reason, and work backward

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

QUICK REVIEW

A slope is a ratio of changes, not simply a difference of outputs. After finding m, recover $b = y - mx$; the intercept is not usually the first listed output. For slope -2 through $(3, 4)$, $b = 4 - (-2)(3) = 10$. Substitute a second point to detect a sign error or an incorrect intercept.

Worked example

Example for form 2: construct a line. Use $(0, 3)$ and $(2, 9)$. Write $y = mx + b$.

1. The slope is $m = (9 - (3))/(2 - (0)) = 3$. Substitute $(0, 3)$ into $y = mx + b$.

2. $3 = 3(0) + b$, so $b = 3 - (0) = 3$. The rule is $y = 3x + 3$.

3. Check the other point: $3(2) + (3) = 9 = 9$. Both given pairs satisfy the equation.

Answer: $y = 3x + 3$

Practice Problems

Show your thinking.

1. A learner reports slope 8 by subtracting outputs only. Build the correct rule. Use $(1, 5)$ and $(5, 13)$. Write $y = mx + b$.

2. A learner uses the first output as the intercept. Recover the correct rule. Use $(2, 9)$ and $(4, 15)$. Write $y = mx + b$.

3. Check signs carefully when both outputs decrease. Use $(1, 8)$ and $(4, -1)$. Write $y = mx + b$.

4. Reverse-engineer the rule from these measurements. Use $(-3, 10)$ and $(1, 2)$. Write $y = mx + b$.

5. A line has slope 3 and contains $(2, 11)$. Find the missing intercept.

6. A learner proposes $y = 2x + 4$ through $(3, 8)$ with slope 2. Repair the constant.

7. A linear table has $(0, 7), (2, 13), (5, k)$. Find the rule and k.

8. Could one linear function contain $(0, 1), (1, 3), (2, 6)$? Show why or why not.

9. Choose b so $y = -2x + b$ has output -1 at input 4.

10. Find a rule, then test a prediction rather than guessing. Use points $(2, 4)$ and $(6, 10)$; find y at $x = 8$.

Answer Key

1. $y = 2x + 3$
2. $y = 3x + 3$
3. $y = -3x + 11$
4. $y = -2x + 4$
5. $b = 5$; $y = 3x + 5$.
6. $y = 2x + 2$
7. $y = 3x + 7$; $k = 22$.
8. No.
9. $b = 7$
10. $y = 13$; $y = \frac{3}{2}x + 1$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The slope is $m = (13 - (5))/(5 - (1)) = 2$. Substitute $(1, 5)$ into $y = mx + b$.

2. $5 = 2(1) + b$, so $b = 5 - (2) = 3$. The rule is $y = 2x + 3$.

3. Check the other point: $2(5) + (3) = 13 = 13$. Both given pairs satisfy the equation.

Problem 2

1. The slope is $m = (15 - (9))/(4 - (2)) = 3$. Substitute $(2, 9)$ into $y = mx + b$.

2. $9 = 3(2) + b$, so $b = 9 - (6) = 3$. The rule is $y = 3x + 3$.

3. Check the other point: $3(4) + (3) = 15 = 15$. Both given pairs satisfy the equation.

Problem 3

1. The slope is $m = (-1 - (8))/(4 - (1)) = -3$. Substitute $(1, 8)$ into $y = mx + b$.

2. $8 = -3(1) + b$, so $b = 8 - (-3) = 11$. The rule is $y = -3x + 11$.

3. Check the other point: $-3(4) + (11) = -1 = -1$. Both given pairs satisfy the equation.

Problem 4

1. The slope is $m = (2 - (10))/(1 - (-3)) = -2$. Substitute $(-3, 10)$ into $y = mx + b$.

2. $10 = -2(-3) + b$, so $b = 10 - (6) = 4$. The rule is $y = -2x + 4$.

3. Check the other point: $-2(1) + (4) = 2 = 2$. Both given pairs satisfy the equation.

Problem 5

1. Substitute $x = 2$ and $y = 11$ into $y = 3x + b$: $11 = 3(2) + b = 6 + b$.

2. Subtract 6: $b = 5$. The resulting rule $y = 3x + 5$ gives $3(2) + 5 = 11$, confirming the point.

Problem 6

1. Test the claim: $2(3) + 4 = 10$, not 8. The slope stays 2, so solve $8 = 2(3) + b$.

2. This gives $b = 8 - 6 = 2$. Replace 4 by 2; then $2(3) + 2 = 8$ verifies the corrected equation.

Problem 7

1. The first two points give $m = (13 - 7)/(2 - 0) = 3$, and the row at $x = 0$ gives $b = 7$.

2. The rule is $y = 3x + 7$. Therefore $k = 3(5) + 7 = 22$, which continues the same three-units-per-input rate.

Problem 8

1. The first two points require $m = (3 - 1)/(1 - 0) = 2$ and $b = 1$, so their line is $y = 2x + 1$.

2. At $x = 2$, that line gives $2(2) + 1 = 5$, not 6. The third point fails, so no single linear function contains all three.

Problem 9

1. The required input-output pair is $(4, -1)$. Substitute it: $-1 = -2(4) + b = -8 + b$.

2. Add 8 to both sides: $b = 7$. Check $-2(4) + 7 = -8 + 7 = -1$, so the recovered intercept meets the condition.

Problem 10

1. The slope is $m = (10 - (4))/(6 - (2)) = \frac{3}{2}$. Substitute $(2, 4)$ into $y = mx + b$.

2. $4 = \frac{3}{2}(2) + b$, so $b = 4 - (3) = 1$. The rule is $y = \frac{3}{2}x + 1$.

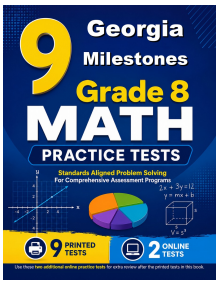
3. Evaluate the completed model: $y = \frac{3}{2}(8) + (1) = 13$. This is the output at the requested input.

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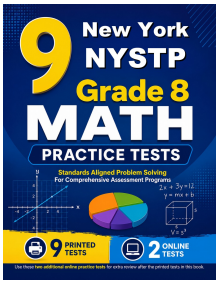
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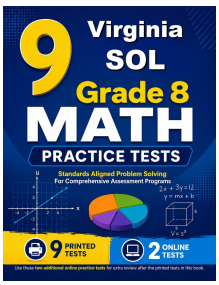
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