Slope and the Equations of a Line

Line Equations: Reverse Conditions and Repair Claims

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

QUICK REVIEW

A proposed equation must satisfy every given condition. Check a point by substitution and compare the coefficient of x with the required slope. Equal slopes give parallel nonvertical lines unless intercepts also match. A point on the x-axis has $y = 0$, not $x = 0$. Reconstruct missing parameters with equations such as $5 = 2(1) + b$, which gives $b = 3$.

Worked example

Kai claims slope 2 through $(1, 5)$ gives $y = 2x + 5$. Repair the equation.

1. Kai used the output 5 as the intercept, but the input is 1, not 0. His equation predicts $2(1) + 5 = 7 \neq 5$.

2. Substitute the known point into $y = mx + b$: $5 = (2)(1) + b$. Since the product is 2, $b = 3$.

3. The equation is $y = 2x + 3$. Check the known point: $(2)(1) + (3) = 5$, so the line has the required point and slope.

Answer: $y = 2x + 3$.

Practice Problems

Show your thinking.

1. A student gives $y = 3x + 4$ for slope 3 through $(2, 4)$. Correct the intercept.

2. Find c so that $y = cx - 2$ passes through $(3, 7)$.

3. Write a line parallel to $y = -2x + 7$ through $(1, 1)$.

4. Are $y = \frac{1}{2}x + 3$ and $2y = x + 6$ different lines? Justify.

5. A line has x-intercept 4 and y-intercept -2. Find its equation.

6. For $y = -3x + b$, choose b so the x-intercept is 2.

7. A student rewrites $3x - 2y = 8$ as $y = -\frac{3}{2}x + 4$. Correct both signs.

8. Design two distinct lines of slope 4, one through $(0, 1)$ and the other through $(0, -2)$. Do they meet?

9. Does $(2, -1)$ lie on $y = -2x + 3$? Does $(2, 1)$? Show both checks.

10. Find a line through $(2, 6)$ that also passes through the origin. Explain why it is proportional.

Answer Key

1. $y = 3x - 2$.
2. $c = 3$.
3. $y = -2x + 3$.
4. No; they are the same line.
5. $y = \frac{1}{2}x - 2$.
6. $b = 6$.
7. $y = \frac{3}{2}x - 4$.
8. $y = 4x + 1$ and $y = 4x - 2$; no intersection.
9. $(2, -1)$ does; $(2, 1)$ does not.
10. $y = 3x$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The proposed equation gives $3(2) + 4 = 10$, not 4. The slope is correct, but the constant must be found by substitution.

2. Substitute the known point into $y = mx + b$: $4 = (3)(2) + b$. Since the product is 6, $b = -2$.

3. The equation is $y = 3x - 2$. Check the known point: $(3)(2) + (-2) = 4$, so the line has the required point and slope.

Problem 2

1. Substitute the given coordinates: $7 = 3c - 2$. Here the unknown c is the slope, while the intercept is already fixed at -2.

2. Add 2 to both sides to obtain $9 = 3c$. Divide by 3 to get $c = 3$.

3. The resulting line is $y = 3x - 2$. Check $3(3) - 2 = 9 - 2 = 7$, so the reconstructed coefficient makes the point fit.

Problem 3

1. Parallel nonvertical lines have equal slopes, so use $m = -2$. The new line must pass through $(1, 1)$ rather than sharing the old intercept.

2. Substitute the known point into $y = mx + b$: $1 = (-2)(1) + b$. Since the product is -2, $b = 3$.

3. The equation is $y = -2x + 3$. Check the known point: $(-2)(1) + (3) = 1$, so the line has the required point and slope.

Problem 4

1. Divide both sides of $2y = x + 6$ by 2. This gives $y = \frac{1}{2}x + 3$, exactly the first equation.

2. Both equations therefore have slope $\frac{1}{2}$ and intercept 3. For example, each produces $y = 4$ when $x = 2$.

3. Both give $y = 4$ at $x = 2$ and match for every input. They describe one coincident line, not distinct parallel lines.

Problem 5

1. The intercepts correspond to points $(4, 0)$ and $(0, -2)$. The zero coordinate differs depending on which axis is crossed.

2. Compute $m = (0 - (-2))/(4 - 0) = 2/4 = \frac{1}{2}$. The given vertical intercept is $b = -2$, so write $y = \frac{1}{2}x - 2$.

3. Check both: at $x = 0$, $y = -2$; at $x = 4$, $y = \frac{1}{2}(4) - 2 = 0$. Thus both intercept conditions hold.

Problem 6

1. An x-intercept of 2 means the point $(2, 0)$ lies on the line. Substitute these coordinates into $y = -3x + b$.

2. The equation becomes $0 = -3(2) + b = -6 + b$. Add 6 to both sides to get $b = 6$.

3. The completed equation is $y = -3x + 6$. Checking the intercept gives $-3(2) + 6 = 0$, so the line crosses at $(2, 0)$.

Problem 7

1. Subtract $3x$ from both sides: $-2y = 8 - 3x$. The negative coefficient of y must divide every term on the right.

2. Divide by -2: $y = 8/(-2) - 3x/(-2) = -4 + \frac{3}{2}x$. Both right-side terms change sign.

3. Thus $y = \frac{3}{2}x - 4$. Check $(0, -4)$ in the original equation: $3(0) - 2(-4) = 8$, confirming the corrected intercept.

Problem 8

1. The input-zero points give intercepts 1 and -2. Keeping slope 4 gives equations $y = 4x + 1$ and $y = 4x - 2$.

2. If the lines met, their outputs would match: $4x + 1 = 4x - 2$. Subtracting $4x$ gives $1 = -2$, which is impossible.

3. Therefore the lines are distinct and parallel. Their outputs always differ by $1 - (-2) = 3$, so they never intersect.

Problem 9

1. Both proposed points have $x = 2$. Substitute this once into the equation: $y = -2(2) + 3 = -4 + 3 = -1$.

2. The first point has output -1, equal to the calculated output. Its substitution gives the true statement $-1 = -1$.

3. The second point has output $1 \neq -1$. Its substitution is false, so $(2, 1)$ cannot lie on this line.

Problem 10

1. The slope between $(0, 0)$ and $(2, 6)$ is $(6 - 0)/(2 - 0) = 3$. Passing through the origin fixes the intercept at zero.

2. Substitute the known point into $y = mx + b$: $0 = (3)(0) + b$. Since the product is 0, $b = 0$.

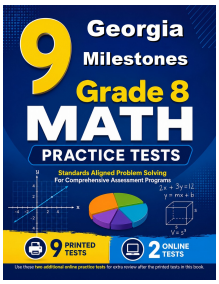
3. The equation is $y = 3x$. Check the known point: $(3)(0) + (0) = 0$, so the line has the required point and slope.

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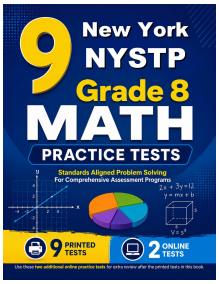
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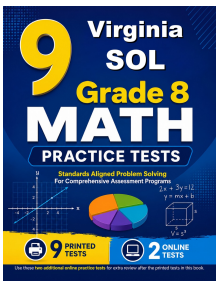
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