Slope and the Equations of a Line

Line Equations: Connect Slope, Points, and Intercepts

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

QUICK REVIEW

A nonvertical line can be written $y = mx + b$. The slope m measures rise per unit run; b is the output when $x = 0$. Given m and (x, y), substitute to find $b = y - mx$. For two points, first calculate $m = \Delta y/\Delta x$. Horizontal lines use $y = b$; vertical lines use $x = a$ instead of slope-intercept form.

Worked example

Write the equation with slope 2 through $(3, 1)$.

1. The slope is already given as $m = 2$. Begin with $y = 2x + b$; the unknown intercept must make the point $(3, 1)$ fit.

2. Substitute the known point into $y = mx + b$: $1 = (2)(3) + b$. Since the product is 6, $b = -5$.

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

Answer: $y = 2x - 5$.

Practice Problems

Show your thinking.

1. Find the line with slope 3 through $(2, 8)$.

2. Write the line through $(0, -4)$ and $(2, 2)$.

3. Write an equation from the table $(0, 5), (2, 4), (6, 2)$.

4. Find the line with slope -2 and y-intercept 3.

5. For $y = \frac{3}{4}x - 6$, identify the slope and y-intercept, then find y at $x = 8$.

6. Rewrite $2x + y = 7$ in slope-intercept form.

7. Write the line through $(-2, 5)$ and $(4, -1)$.

8. Write the equation of the horizontal line through $(6, -3)$.

9. Write the equation of the vertical line through $(-4, 2)$.

10. A line rises 2 for a run of 5 and crosses the y-axis at -1. Write its equation.

Answer Key

1. $y = 3x + 2$.
2. $y = 3x - 4$.
3. $y = -\frac{1}{2}x + 5$.
4. $y = -2x + 3$.
5. $m = \frac{3}{4}$, $b = -6$; $y = 0$.
6. $y = -2x + 7$.
7. $y = -1x + 3$.
8. $y = -3$.
9. $x = -4$.
10. $y = \frac{2}{5}x - 1$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Use the stated slope $m = 3$ in $y = mx + b$. The known point $(2, 8)$ supplies an input and output for determining the intercept.

2. Substitute the known point into $y = mx + b$: $8 = (3)(2) + b$. Since the product is 6, $b = 2$.

3. The equation is $y = 3x + 2$. Check the known point: $(3)(2) + (2) = 8$, so the line has the required point and slope.

Problem 2

1. Calculate $m = (2 - (-4))/(2 - 0) = 6/2 = 3$. The point with input zero also gives the intercept directly as -4.

2. Substitute the known point into $y = mx + b$: $-4 = (3)(0) + b$. Since the product is 0, $b = -4$.

3. The equation is $y = 3x - 4$. Check the known point: $(3)(0) + (-4) = -4$, so the line has the required point and slope.

Problem 3

1. The successive rates are $(4 - 5)/(2 - 0) = -\frac{1}{2}$ and $(2 - 4)/(6 - 2) = -\frac{1}{2}$. They agree, so the table represents one line.

2. Substitute the known point into $y = mx + b$: $5 = (-\frac{1}{2})(0) + b$. Since the product is 0, $b = 5$.

3. The equation is $y = -\frac{1}{2}x + 5$. Check the known point: $(-\frac{1}{2})(0) + (5) = 5$, so the line has the required point and slope.

Problem 4

1. The intercept means the point $(0, 3)$ is on the line. The given slope is -2, so begin with $y = -2x + b$.

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

3. The equation is $y = -2x + 3$. Check the known point: $(-2)(0) + (3) = 3$, so the line has the required point and slope.

Problem 5

1. Compare $y = \frac{3}{4}x - 6$ with $y = mx + b$. The coefficient of x is $\frac{3}{4}$ and the constant term is -6.

2. The vertical intercept is $(0, -6)$ because substituting $x = 0$ gives $y = \frac{3}{4}(0) - 6 = -6$.

3. For $x = 8$, calculate $y = \frac{3}{4}(8) - 6 = 6 - 6 = 0$. Thus the requested output is exactly zero.

Problem 6

1. Subtract $2x$ from both sides of $2x + y = 7$. This isolates y and gives $y = -2x + 7$, so the slope is -2.

2. Substitute the known point into $y = mx + b$: $7 = (-2)(0) + b$. Since the product is 0, $b = 7$.

3. The equation is $y = -2x + 7$. Check the known point: $(-2)(0) + (7) = 7$, so the line has the required point and slope.

Problem 7

1. Compute slope with consistent differences: $m = (-1 - 5)/(4 - (-2)) = -6/6 = -1$. Use either given point to determine the intercept.

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

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

Problem 8

1. A horizontal line has no vertical change. For example, $(0, -3)$ and $(6, -3)$ give slope $(-3 - (-3))/(6 - 0) = 0$.

2. Use $y = 0x + b$ and substitute $(6, -3)$: $-3 = 0(6) + b$, so $b = -3$. The input term contributes zero.

3. The equation simplifies to $y = -3$. Every point with output -3 lies on this line, including the required point $(6, -3)$.

Problem 9

1. A vertical line keeps the same input at every point. Through $(-4, 2)$, that fixed input is -4, regardless of the output.

2. Two points on it are $(-4, 0)$ and $(-4, 2)$. Their slope would be $(2 - 0)/(-4 - (-4)) = 2/0$, which is undefined.

3. Therefore use $x = -4$, not $y = mx + b$. Substituting the given point produces the true statement $-4 = -4$.

Problem 10

1. The rise-run ratio is $m = 2/5 = \frac{2}{5}$. The stated vertical intercept supplies the point $(0, -1)$ for the equation.

2. Substitute the known point into $y = mx + b$: $-1 = (\frac{2}{5})(0) + b$. Since the product is 0, $b = -1$.

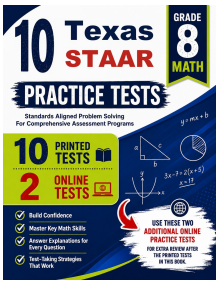
3. The equation is $y = \frac{2}{5}x - 1$. Check the known point: $(\frac{2}{5})(0) + (-1) = -1$, so the line has the required point and slope.

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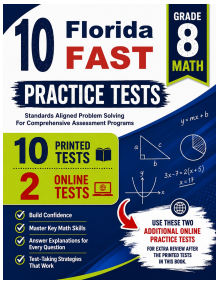
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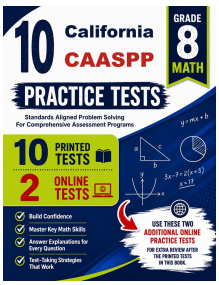
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