Working With Straight Lines

Important Information & Formulas

1. ax + by = c -- **Standard form of a line**, where *a*, *b*, and *c* are real numbers, and *a* and *b* are not both zero.

2. y = mx + b -- **Slope-intercept formula**, where *m* is the slope and *b* is the y-intercept.

3. $(y - y_1) = m(x - x_1)$ -- **Point-slope formula**, where *m* is the slope and (x_1, y_1) is a point given.

4. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$ -- **Slope formula**.

5. A line is **parallel** to another line if their slopes are equal.

   For example if:

   1. $m_1 = \dfrac{3}{4}$; parallel $m_2 = \dfrac{3}{4}$

6. A line is **perpendicular** to another line if their slopes are negative reciprocals.

   For example if:

   $m_1 = 2$; perpendicular $m_2 = -\dfrac{1}{2}$

7. The **x - intercept** is a point when y = 0; (x, 0).

8. The **y - intercept** is a point when x = 0; (0, y).

Examples

1. Given two points (3, 5) and (2, -3)
   (x_1, y_1) (x_2, y_2)

   Find the equation of the line and write in standard form:

   a. Find the slope. Remember: $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

$$m = \frac{-3-5}{2-3} = \frac{-8}{-1} = \frac{8}{1} = 8$$

b. Use the point-slope formula. Remember: $(y - y_1) = m(x - x_1)$

$$y - 5 = 8(x - 3)$$
$$y - 5 = 8x - 24$$
$$\underline{-8x \quad -8x}$$
$$-8x + y - 5 = -24$$
$$\underline{+5 \quad +5}$$
$$8x + y = -19$$

2. Given $m = -\frac{3}{2}$ and a y-intercept of $(0,-3)$. Write an equation for a line.
(Hint: Use slope-intercept formula) $y = mx + b$

$$y = -\frac{3}{2}x + (-3)$$
$$y = -\frac{3}{2}x - 3$$

3. Find an equation through (5,3) which is parallel to the line 4x + 5y = -10.
   a. Place the standard form equation into $y = mx + b$ form (slope-int form) so that we can identify the slope.

$$4x + 5y = -10$$
$$\underline{-4x \quad -4x}$$
$$\frac{5y}{5} = -\frac{4x}{5} - \frac{10}{5}$$
$$y = -\frac{4}{5}x - 2$$

therefore $m_1 = -\frac{4}{5}$

   b. If $m_1 = -\frac{4}{5}$, the slope of the parallel line is $m_2 = -\frac{4}{5}$. Given the point (5, 3), use the point-slope formula: $(y - y_1) = m(x - x_1)$

$$y - 3 = -\frac{4}{5}(x - 5)$$
$$y - 3 = -\frac{4}{5}x + \frac{20}{5}$$
$$y - 3 = -\frac{4}{5}x + 4$$
$$\underline{+3 \quad +3}$$
$$y = -\frac{4}{5}x + 7$$

4. Find an equation through (4, 3) which is perpendicular to the line 4x + 5y = -2

   a. Place the standard form equation into $y = mx + b$ form so that we can identify the slope.

$$4x + 5y = -2$$
$$\underline{-4x \qquad -4x}$$
$$\frac{5y}{5} = \frac{-4x}{5} - \frac{2}{5}$$
$$y = -\frac{4}{5}x - \frac{2}{5}$$

   b. If $m_1 = -\frac{4}{5}$, the slope of the perpendicular line is $m_2 = \frac{5}{4}$. Given this point (4, 3), use point-slope formula: $(y - y_1) = m(x - x_1)$

$$y - 3 = \frac{5}{4}(x - 4)$$
$$y - 3 = \frac{5}{4}x - \frac{20}{4}$$
$$y - 3 = \frac{5}{4}x - 5$$
$$\underline{\;+3 \qquad\quad +3\;}$$
$$y = \frac{5}{4}x - 2$$

Note: To write in standard form, multiply equation by common denominator

   c. Common denominator is 4

$$4 * \left(y = \frac{5}{4}x - 2 \right)$$

$$4y = 5x - 8$$
$$\underline{-5x \quad -5x \qquad}$$
$$-5x + 4y = -8 \quad or \quad 5x - 4y = 8$$

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