Lines

Formulas:

1. **Slope-intercept form** of a line; where m = slope and b = y-intercept

   y = mx + b

2. **Standard form** of a line; A, B and C are integers with A being positive

   Ax + By = C

3. **Point-slope form** of a line; where m = slope and (x_1,y_1) is a given point

   y $- y_1 = m(x - x_1)$

4. **Slope formula**; where m = slope, and (x_1,y_1) and (x_2,y_2) are two points

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

5. **Midpoint formula**; where (x_1,y_1) and (x_2,y_2) are two points; average the x values for the new x value and the y values for the new y value

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

6. **Distance formula**; where (x_1, y_1) *and* (x_2, y_2) are two points

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Additional Information:

1. A line is **parallel** to another line if their slopes are the same.

   Example: if a line has slope of $m = \frac{3}{5}$; a **parallel** line has $m = \frac{3}{5}$

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

   Example: if a line has slope of $m = \frac{3}{5}$; a **perpendicular** line has $m = -\frac{5}{3}$

3. To find the **y-intercept**, set x to 0: **(0,y)**

4. To find the **x-intercept**, set y to 0: **(x,0)**

Examples:

1. Write the equation of a line in slope-intercept form given slope of $m = \frac{2}{5}$ and y-intercept of (0,-4)

$y = mx + b$ Formula #1 $y = \frac{2}{5}x + (-4)$

$\mathbf{y = \frac{2}{5}x - 4}$ Formula #1 Answer

2. Write the equation of the above line in standard form.

$y = \frac{2}{5}x - 4$ Formula #1

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

$5y = 2x - 20$

$\underline{-2x \qquad -2x}$

$-2x + 5y = -20$

$-1(-2x + 5y) = -1(-20)$ Multiply by -1 so the coefficient of x is positive

$\mathbf{2x - 5y = 20}$ Formula #2 Answer

3. Write the equation of a line in standard form that goes through the points (2,-6) and (-3,4)

First -- find the slope.

$m = \frac{y_2 - y_1}{x_2 - x_1}$ Formula #4

$m = \frac{4-(-6)}{-3-2} = \frac{4+6}{-5} = \frac{10}{-5} = -2$ Formula #4

Second -- use the point-slope form and simplify into standard form, using one set of points; (2,-6)

$y - y_1 = m(x - x_1)$ Formula #3 $y - (-6) = -2(x - 2)$

Formula #3

$y + 6 = -2x + 4$

$\underline{-6 \qquad -6}$

$y = -2x - 2$

$\underline{+2x \qquad +2x}$

$\mathbf{2x + y = -2}$ Formula #2 Answer

4. Write the equation of the above line in slope-intercept form.

$2x + y = -2$ Formula #2

$\underline{-2x \quad -2x}$

$y = -2x - 2$ Formula #1 Answer

5. Find the midpoint of a line with end points of (5,9) and (-3,7).

$M = (\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$ Formula #5

$M = (\frac{5+(-3)}{2}, \frac{9+7}{2},)$ Formula #5

$M = (\frac{5-3}{2}, \frac{16}{2})$

$M = (\frac{2}{2}, \frac{16}{2})$

$M = (1, 8)$ Answer

6. Find the length of a line with endpoints of (5,1) and (-3,7)

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Formula #6

$d = \sqrt{(7-1)^2 + (-3-5)^2}$ Formula #6

$d = \sqrt{(6)^2 + (-8)^2}$

$d = \sqrt{36 + 64}$

$d = \sqrt{100}$

$d = 10\ units$ Answer

Parallel and Perpendicular Lines

7. Find the equation of a line **parallel** to 4x + 2y = -8 passing through (2,4)

First -- find the slope by putting standard form into slope-intercept form.

$4x + 2y = -8$ Formula #2

$\underline{-4x \quad -4x}$

$2y = -4x - 8$

$\frac{2y}{2} \quad \frac{-4x}{2} \quad \frac{8}{2}$

$= -$

$y = -2x - 4$ Formula #1

Therefore $m = -2$

and parallel $m = -2$

Second – use the point-slope form with a **parallel slope of -2** and the given point (2,4)

$y - 4 = -2(x - 2)$ Formula #3

$y - 4 = -2x + 4$

$\mathbf{+4 \quad +4}$

$\boldsymbol{y = -2x + 8}$ Formula #1 Answer

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8. Find the equation of a line **perpendicular** to 3x – 4y = 12 passing through (2,5)

First – find the slope by putting standard form into slope-intercept form.

$3x - 4y = 12$ Formula #2

$\mathbf{-3x \quad -3x}$

$-4y = -3x + 12$

$\frac{-4y}{-4} = \frac{-3x}{-4} + \frac{12}{-4}$

$y = \frac{3}{4}x - 3$ Formula #1

Therefore $\boldsymbol{m} = \frac{3}{4}$ and perpendicular $\boldsymbol{m} = -\frac{4}{3}$

Second – use the point-slope form with a **perpendicular slope of** $-\frac{4}{3}$ and the given point (2,5)

$y - \mathbf{5} = -\frac{4}{3}(x - \mathbf{2})$ Formula #3

$y - 5 = -\frac{4}{3}x + \frac{8}{3}$

$\mathbf{+5 \quad 5}$

$y = -\frac{4}{3}x + \frac{23}{3}$

$\boldsymbol{y = -\frac{4}{3}x + \frac{23}{3}}$ Formula #1 Answer

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