ALGEBRA – EQUATIONS OF LINES

Slope-intercept equation: $y = mx + b$, where m is the slope of the line and b is the y-intercept

Given 2 points $(x_1, y_1)\ and\ (x_2, y_2)$ on the line, the **slope** is the change in y divided by the change in x. Sometimes it is defined as "rise over run" $m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$

A positive slope indicates the y-values on the line increase as the x-values increase. A negative slope indicates the y-values on the line decreases as the x-values increase.

The **y-intercept** is the value of y when x = 0. It is the point *(0, b)* where the line crosses (intercepts) the y-axis (vertical axis).

A line may also have an **x-intercept** – the point *(a, 0)* where the line crosses (intercepts) the x-axis (horizontal axis). The x-intercept is found by setting y = 0 and solving for x.

A line with zero slope is a **horizontal line** and has the equation y = b.

A **vertical line** has an undefined slope and no y-intercept. It has the equation x = a.

To **find the equation of a line** given 2 points on the line:

1. Use the slope formula to calculate the slope. Do not round the slope number. Use fractions or terminating decimals.
2. Replace *m* in the slope-intercept equation with the slope number.
3. Pick one of the 2 given points and in the slope-intercept equation replace *y* with the given y-coordinate and *x* with the given x-coordinate.
4. Solve step 3 for the letter *b* (the y-intercept)
5. Write the line equation replacing *m* and *b* with the values you calculated.

Example Write the equation of the line that passes through the points (3, 10) and (-6, 4)

1. Calculate the slope: $m = \frac{10-4}{3-(-6)} = \frac{6}{9} = \frac{2}{3}$
2. Write the equation using the slope number: $y = \frac{2}{3}x + b$
3. Using the point (3, 10): $10 = \frac{2}{3}(3) + b$
4. Solving for b: 10 = 2 + b so b = 8
5. Equation of the line is $y = \frac{2}{3}x + 8$

Given the slope and 1 point (x_1, y_1) on the line the **Point-Slope equation of a line** is

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

For example, the point-slope equation of the line with slope 4 and passing through the point (3,5) is $y - 5 = 4(x - 3)$