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# Algebra, Part 2 (Quick Study)

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**Quick Study ACADEMIC**

## ALGEBRA - Part 2

PARTS 1 & 2 COMBINED COVER PRINCIPLES FOR BASIC, INTERMEDIATE AND COLLEGE COURSES

### GRAPHING

#### REAL NUMBER LINE

Chart of the graphs on the real number line of solutions to one-variable equations:

#### SYMBOL & GRAPHIC NOTATION

• OPEN, CIRCLED CIRCLE	Ex. $x = 2$
• OPEN, OPEN CIRCLE AND RAY	Ex. $x > 4$
• OPEN, OPEN CIRCLE AND RAY	Ex. $x < -1$
• OPEN, CLOSED CIRCLE AND RAY	Ex. $x \geq 3$
• OPEN, CLOSED CIRCLE AND RAY	Ex. $x \leq 2$

\* Direction of ray is determined by picking (at random) a value on each side of the circle. Ray goes in direction of the point which makes the inequality true.

#### ABSOLUTE VALUE STATEMENTS

- Equation:** To solve  $|ax + b| = c$ , where  $c > 0$ , solve both equations  $ax + b = c$  and  $ax + b = -c$ , and graph the union of the two solutions.
- Inequality:**
  - To solve  $|ax + b| < c$ , where  $c > 0$ , solve  $ax + b < c$  and  $ax + b > -c$ ; these two inequalities may be written as one  $-c < ax + b < c$ ; graph the intersection of the two solutions.
  - To solve  $|ax + b| > c$ , where  $c > 0$ , solve  $ax + b > c$  or  $ax + b < -c$ ; graph the union of the two solutions.

#### RECTANGULAR (OR CARTESIAN) COORDINATE SYSTEM

Method: using two perpendicular lines intersecting at 90 degree angles. An locating and naming points in a plane. The vertical line is the y-axis. The horizontal line is the x-axis. The point where the two axes intersect is called the origin.

#### LOCATING POINTS (ORDERED PAIRS)

Each point on coordinate plane is named or located by using an ordered pair of numbers separated by a comma and enclosed in a set of parentheses, first number is x-coordinate or abscissa; second number is y-coordinate or ordinate; that is, an ordered pair is of the form  $(x, y)$ . The origin is  $(0, 0)$ .

#### QUADRANTS

The x-axis and the y-axis separate the plane into fourths. Each fourth is called a quadrant. The quadrants are labeled using Roman numerals, starting in the upper right corner, and continuing counterclockwise through quadrants I, II, III, and IV which is located in the lower right corner.

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

Each distance between two points,  $(x_1, y_1)$  and  $(x_2, y_2)$  is derived from the application of the Pythagorean Theorem and always results in a non-negative number.

#### MIDPOINT FORMULA: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Determines the coordinates of the midpoint of a line segment with end points of  $(x_1, y_1)$  and  $(x_2, y_2)$ .

### LINES

#### SLOPE OF A LINE

The slope of a line can be described as direction of the line. If the line starts up on the right end of the line then the slope will be a positive number. If the line starts up on the left end of the line then the slope will be a negative number. If the line is horizontal then the slope is zero. If the line is vertical then the line has no slope; it is undefined.

- FORMULA:** If line is not vertical then slope (indicated by  $m$ ) can be found using two distinct points  $A = (x_1, y_1)$  and  $B = (x_2, y_2)$  of the line and using x-coordinates and y-coordinates in the formula:  
 $m = \frac{y_2 - y_1}{x_2 - x_1}$ , change in y = rise, change in x = run
- PARALLEL:** The slopes of parallel lines are equal.
- PERPENDICULAR:** The slopes of perpendicular lines are negative reciprocals. If the slope of  $L_1$  is  $m_1$  and the slope of  $L_2$  is  $m_2$ , and the lines are perpendicular then  $m_1 = -\frac{1}{m_2}$  or  $(m_1 m_2) = -1$ . EX: If the slope of a line is  $-\frac{3}{4}$  then the slope of the line which is perpendicular to it is  $\frac{4}{3}$ .

#### LINEAR EQUATIONS (EQUATIONS OF LINES)

- Since the coordinate system has an x-axis and a y-axis, lines which intersect the x-axis contain the variable x in the linear equation. Lines which intersect the y-axis contain the variable y in the linear equation, and lines which intersect both the x-axis and the y-axis have both variables x and y in the linear equation.
- Slope-intercept form** of equation of a line is  $y = mx + b$  where  $m$  is the slope of the line and  $b$  is the y-intercept (y-value of the point where the line intersects y-axis).
- Standard form** of the equation of a line is  $ax + by = c$  where the number values for  $a$ ,  $b$ , and  $c$  are integers (note that the  $b$  does not represent the y-intercept in this form).

#### GRAPHING

When equation of a line is given, it may be graphed in any of the following ways:

- Horizontal lines** have equations which simplify to the form  $y = b$ , where  $b$  is the y-intercept. The slope of these lines is zero.
- Vertical lines** have equations which simplify to form  $x = c$ , where  $c$  is the x-intercept. They have no slope.
- Find at least two points** which make the equation true and one other face on the line. Finding a third point is one method of checking for errors. If all three points do not form a line then there is an error in at least one of the points. To find three points:
  - Choose a number at random.
  - Substitute the number into the linear equation for either the x or the y variable in the equation.
  - Solve the resulting equation for the other variable.
  - The randomly selected number (step a) and solution number (step c) result in one point  $(x, y)$ .
  - Repeat above steps a through d above as indicated until the desired number of points have been created.
- Plot the x-intercept and the y-intercept.**
  - Substitute zero for the y variable in the equation and solve for x to find the x-intercept.
  - Substitute zero for the x variable in the equation and solve for y to find the y-intercept.
  - Plot these two points and draw the graph of the line which contains them.
  - NOTE:** Lines which have the same point as the y-intercept and the x-intercept, that is, the origin  $(0, 0)$ , must have at least one other point located in order to draw the graph of the line.
- Write the equation in the slope-intercept form**, plot the point where the line crosses the y-axis (the horizontal), use the slope to plot additional points on the line (rise over run). Connect the points to draw the graph of the line.
- Find the slope of the line and one point on the line.** Plot the point first. Then use the slope to plot additional points on the line. That is, count the rise over run beginning at the point which was just plotted.



## Synopsis

Algebra 2 is the advanced QuickStudy guide specially designed for students who are already familiar with Algebra 1.

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