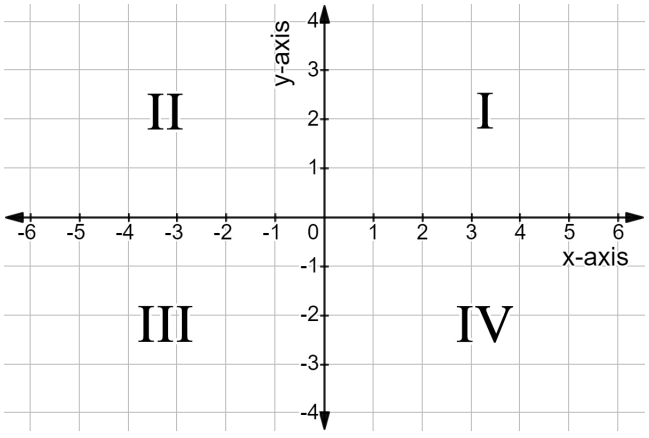
Coordinate System and Lines

1 Coordinates and Graphs

1.1 Introduction to the Coordinate Plane

A **Cartesian plane** or **coordinate plane** is formed by two perpendicular number lines, intersect at 0 at each. A coordinate plane has seven basic parts: the two axes, the origin, and four quadrants. The number lines are the **axes**, and the point at which the axes intersect is the **origin**, O. The horizontal axis is called the **x-axis**, and the vertical axis is called the **y-axis**. The axes divide a coordinate plane into four quadrants, labeled I, II, III, and IV.



Each point P on a coordinate plane corresponds to a unique pair oof real numbers called an **ordered pair**. In any pair (a, b), the first number a, is the **x-coordinate**, corresponding to a location indicated by the x-axis, and the second number b, is the **y-coordinate**, corresponding to a location indicated by the y-axis.

1.2 The Distance and Midpoint Formulas

The Distance Formula: The distance d between two points (x_1, y_1) and (x_2, y_2) on a coordinate plane is

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

The Midpoint Formula: The midpoint between two points (x_1, y_1) and (x_2, y_2) on a coordinate plane is

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

1.3 Graphing Equation by Plotting Points

Steps for Graphing an Equation by Plotting Points

- Choose several allowable values for x
- Substitute each x-value into the equation and find the corresponding y-value, resulting in an ordered pair solution (x, y) to the equation. List these ordered pair solutions in a two-column table.
- Plot each ordered pair (x, y) on a coordinate plane.
- Connect the points with a straight line or smooth curve.

1.4 Finding the x- and y- intercepts of an Equation

Definition: An **x-intercept** of an equation is a point at which the equation's graph intersects the x-axis. They y-coordinate of an x-intercept is always 0. An **y-intercept** of an equation is a point at which the equation's graph intersects the y-axis. They x-coordinate of an y-intercept is always 0.

2 Lines

2.1 Equation of Lines

General Form of the Equation of a Line: A **Linear Equation** is an equation that can be written in the general form $Ax + By + C = 0$, where A, B, and C are real numbers and A and B cannot both be 0.

Slope-Intercept Form of the Equation of a Line: The equation of the line with slope m and y-intercept b is

$$y = mx + b$$

Point-Slope Form of the Equation of a Line: The equation of the line with slope m that passes through (x_1, y_1) is

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

2.2 Parallel and Perpendicular Lines

Point-Slope Form of the Equation of a Line:

- Parallel lines have equal slopes
- Perpendicular lines have slopes that are opposite reciprocals of one another
- The product of the slopes of two perpendicular lines is equal to -1
- All vertical lines are parallel
- All horizontal lines are parallel
- A vertical line is perpendicular to any horizontal line
- A horizontal line is perpendicular to any vertical line