Coordinate Geometry Formula Sheet

Basic Concepts and Definitions

Coordinate System (Cartesian System)

- **Origin (O)**: Point where x-axis and y-axis intersect → **(0, 0)**
- **x-axis**: Horizontal line passing through origin
- **y-axis**: Vertical line passing through origin
- **Coordinate Plane**: Plane formed by x-axis and y-axis

Point Coordinates

- Any point P in the plane is represented as **P(x, y)**
- **x-coordinate (Abscissa)**: Perpendicular distance from y-axis
- **y-coordinate (Ordinate)**: Perpendicular distance from x-axis

Quadrants and Signs

Quadrant	Sign Pattern	Description
I (First)	(+, +)	Both coordinates positive
II (Second)	(−, +)	x negative, y positive
III (Third)	(−, −)	Both coordinates negative
IV (Fourth)	(+, −)	x positive, y negative

Special Points

Points on Axes

- **Point on x-axis**: **(x, 0)** where y-coordinate = 0
- **Point on y-axis**: **(0, y)** where x-coordinate = 0
- **Origin**: **(0, 0)**

Important Properties

- **Unique Representation**: Each point has exactly one coordinate pair
- **Order Matters**: (x, y) ≠ (y, x) unless x = y
- **Distance from Origin**: Point (x, y) is at distance $\sqrt{(x^2 + y^2)}$ from origin

Coordinate Rules

Reading Coordinates

1. **x-coordinate**: Count units horizontally from y-axis
   - Positive: Right of y-axis
   - Negative: Left of y-axis
2. **y-coordinate**: Count units vertically from x-axis
   - Positive: Above x-axis
   - Negative: Below x-axis

Writing Coordinates

- Always write as **(x-coordinate, y-coordinate)**
- First value = horizontal position
- Second value = vertical position

Key Formulas (For Future Reference)

Distance Between Two Points

For points A(x_1, y_1) and B(x_2, y_2): **Distance = $\sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$**

Midpoint of Line Segment

For points A(x_1, y_1) and B(x_2, y_2): **Midpoint = $((x_1 + x_2)/2, (y_1 + y_2)/2)$**

Area of Triangle

For triangle with vertices A(x_1, y_1), B(x_2, y_2), C(x_3, y_3): **Area = $\frac{1}{2}|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$**

Quick Reference Chart

Quadrant Identification

- **I**: x > 0, y > 0 (Top-right)
- **II**: x < 0, y > 0 (Top-left)
- **III**: x < 0, y < 0 (Bottom-left)
- **IV**: x > 0, y < 0 (Bottom-right)

Axis Points

- **Positive x-axis**: (a, 0) where a > 0
- **Negative x-axis**: (−a, 0) where a > 0
- **Positive y-axis**: (0, b) where b > 0
- **Negative y-axis**: (0, −b) where b > 0

Memory Tips

1. **"Right-Up" Rule**: x increases going right, y increases going up

2. **Alphabetical Order**: x comes before y in coordinates (x, y)
3. **Quadrant Counter**: Number quadrants I, II, III, IV counter-clockwise from positive x-axis
4. **Sign Pattern**:
    - Quadrant I: Both positive (like northeast)
    - Quadrant II: x negative, y positive (like northwest)
    - Quadrant III: Both negative (like southwest)
    - Quadrant IV: x positive, y negative (like southeast)

Common Mistakes to Avoid

- ❌ Confusing (x, y) with (y, x)
- ❌ Wrong quadrant identification
- ❌ Forgetting that axes points have one coordinate as zero
- ❌ Incorrect sign assignment in different quadrants

Named after René Descartes (1596-1650), French mathematician and philosopher