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The Distance Formula

Given points $P(x_1, y_1)$ and $Q(x_2, y_2)$, the distance from P to Q, denoted as PQ, can be found using the formula below. This formula is called the distance formula.

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

Example 1: Given $P(3, 2)$ and $Q(-1, 5)$

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

$$x_1 = 3 \quad y_1 = 2 \quad PQ = \sqrt{(-1 - 3)^2 + (5 - 2)^2}$$

$$x_2 = -1 \quad y_2 = 5 \quad PQ = \sqrt{(-4)^2 + (3)^2} = \sqrt{16 + 9}$$

$$PQ = \sqrt{25} = 5$$

Therefore, the distance from $(3, 2)$ to $(-1, 5)$ is 5 units.

Example 2: Given $P(-3, 4)$ and $Q(3, 4)$

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

$$x_1 = -3 \quad y_1 = 4 \quad PQ = \sqrt{(3 - (-3))^2 + (4 - 4)^2}$$

$$x_2 = 3 \quad y_2 = 4 \quad PQ = \sqrt{(6)^2 + (0)^2} = \sqrt{36 + 0}$$

$$PQ = \sqrt{36} = 6$$

Therefore, the distance from $(-3, 4)$ to $(3, 4)$ is 6 units.

Example 3: Given $P(4, 1)$ and $Q(-3, 3)$

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

$$x_1 = 4 \quad y_1 = 1 \quad PQ = \sqrt{(-3 - 4)^2 + (3 - 1)^2}$$

$$x_2 = -3 \quad y_2 = 3 \quad PQ = \sqrt{(-7)^2 + (2)^2} = \sqrt{49 + 4}$$

$$PQ = \sqrt{53} \approx 7.3$$

Therefore, the distance from $(4, 1)$ to $(-3, 3)$ is about 7.3 units.

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The Equations of a Circle

General Form: $x^2 + y^2 + Dx + Ey + F = 0$

Standard Form: $(x - h)^2 + (y - k)^2 = r^2$ where r is the radius measure and (h,k) is the center.

Example 1: Given the circle with center $(2, 5)$ and radius measure 3.

Find the standard form equation and the general form equation.

$$h = 2 ; k = 5 ; r = 3$$

Standard Form: $(x - 2)^2 + (y - 5)^2 = 9$

$$x^2 - 4x + 4 + y^2 - 10y + 25 = 9$$

$$x^2 + y^2 - 4x - 10y + 29 = 9$$

General Form: $x^2 + y^2 - 4x - 10y + 20 = 0$

Example 2: Given the circle with center $(-5, 0)$ and radius measure 5.

Find the standard form equation and the general form equation.

$$h = -5 ; k = 0 ; r = 5$$

$$(x - (-5))^2 + (y - 0)^2 = 25$$

Standard Form: $(x + 5)^2 + y^2 = 25$

$$x^2 + 10x + 25 + y^2 = 25$$

$$x^2 + y^2 + 10x + 25 = 25$$

General Form: $x^2 + y^2 + 10x = 0$

Example 3: Given: A circle has general form equation $x^2 + y^2 - 6x + 4y - 3 = 0$.

Find the standard form equation and graph the circle.

$$x^2 + y^2 - 6x + 4y - 3 = 0$$

$$(x^2 - 6x) + (y^2 + 4y) = 3$$

$$(x^2 - 6x + 9) + (y^2 + 4y + 4) = 3 + 9 + 4$$

Standard Form Equation

$$(x - 3)^2 + (y + 2)^2 = 16$$

$$h = 3 ; k = -2 ; r^2 = 16$$

center $(3, -2)$ radius 4

