

# PRECALC - §10-1 NOTES

## PRECALCULUS NOTES

### 10.1 Introduction to Analytic Geometry

**Objectives:** Find the distance and midpoint between two points on a coordinate grid.  
Prove geometric relationships among points and lines using analytical methods.

#### DISTANCE FORMULA

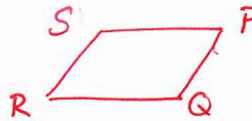
The distance between two points  $(x_1, y_1)$  and  $(x_2, y_2)$  is given by the formula:

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

**Example 1** Find the distance between the points  $(4, -2)$  and  $(8, 3)$

$$\begin{aligned} d &= \sqrt{(8-4)^2 + (3-(-2))^2} \\ &= \sqrt{4^2 + 5^2} \\ &= \sqrt{16 + 25} \\ &= \sqrt{41} \end{aligned}$$

**Example 2** Determine whether quadrilateral PQRS with vertices  $P(-4, 2)$ ,  $Q(-3, -2)$ ,  $R(3, -3)$  and  $S(1, 5)$  is a parallelogram.



Verify either:

- 1) opp. sides parallel  $\Rightarrow$  same slopes
- 2) opp sides  $\cong$   $\Rightarrow$  same length (distance)

$$\begin{array}{l} m_{PQ} = \frac{-2-2}{-3-(-4)} = -4 \\ m_{RS} = \frac{5-(-3)}{1-3} = -4 \\ \text{same slopes} \end{array} \quad \begin{array}{l} m_{PS} = \frac{5-2}{1-(-4)} = \frac{3}{5} \\ m_{QR} = \frac{-3-(-2)}{3-(-3)} = -\frac{1}{6} \\ \text{different slopes} \end{array}$$

**NOT A PARALLELOGRAM**

**MIDPOINT FORMULA**

If the coordinates of  $P_1$  and  $P_2$  are  $(x_1, y_1)$  and  $(x_2, y_2)$  respectively,

then the midpoint of  $\overline{P_1P_2}$  is:

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

**Example 3**

Find the coordinates of the midpoint of the segment that has endpoints at  $(2, 5)$  and  $(-4, -7)$ .

$x_1$   $y_1$   $x_2$   $y_2$

$$\text{midpoint} = \left( \frac{2 + (-4)}{2}, \frac{5 + (-7)}{2} \right)$$

$$= \left( \frac{-2}{2}, \frac{-2}{2} \right)$$

$$= (-1, -1)$$