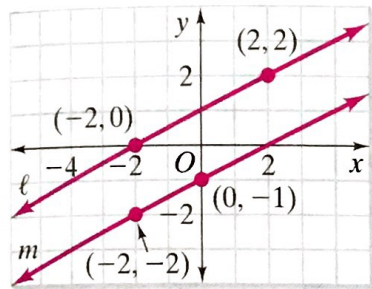


Parallel and Perpendicular Lines

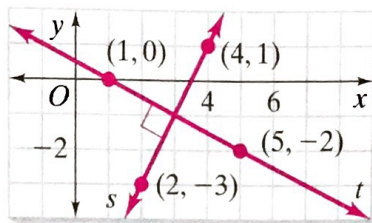
The slopes of parallel and perpendicular lines have special properties



$$\text{slope of } \ell = \frac{2 - 0}{2 - (-2)} = \frac{2}{4} = \frac{1}{2}$$

$$\text{slope of } m = \frac{-1 - (-2)}{0 - (-2)} = \frac{1}{2}$$

Parallel lines have the same slope.



$$\text{slope of } s = \frac{1 - (-3)}{4 - 2} = \frac{4}{2} = \frac{2}{1}$$

$$\text{slope of } t = \frac{-2 - 0}{5 - 1} = \frac{-2}{4} = -\frac{1}{2}$$

$$\text{product of slopes} = \frac{2}{1} \cdot \left(-\frac{1}{2}\right) = -1$$

The product of the slopes of perpendicular lines is -1 .

EXAMPLE

Line AB has slope $\frac{1}{3}$. Find the slope of a line that is parallel to \overleftrightarrow{AB} and the slope of a line that is perpendicular to \overleftrightarrow{AB} .

A line parallel to \overleftrightarrow{AB} has a slope of $\frac{1}{3}$.

Let m represent the slope of a line perpendicular to \overleftrightarrow{AB} .

$$\frac{1}{3} \cdot m = -1 \quad \leftarrow \text{The product of the slopes of perpendicular lines is } -1.$$

$$m = -3 \quad \leftarrow \text{Multiply each side by 3.}$$

A line perpendicular to \overleftrightarrow{AB} has a slope of -3 .

Exercises

Are lines with the given slopes *parallel*, *perpendicular*, or *neither*?

1. $\frac{2}{3}, -\frac{3}{2}$

2. $5, -5$

3. $\frac{3}{4}, \frac{4}{3}$

4. $\frac{1}{12}, -12$

5. $\frac{3}{9}, \frac{1}{3}$

6. $\frac{2}{7}, \frac{12}{42}$

Find the slope of a line parallel to \overleftrightarrow{PQ} and a line perpendicular to \overleftrightarrow{PQ} .

7. $P(1, 2), Q(3, 4)$

8. $P(-5, 1), Q(-1, 2)$

9. $P(3, -2), Q(-2, 1)$