LESSON MAKER PRO

# Slope Proof Lab

*Use slope to prove parallel and perpendicular lines.*

**HIGH SCHOOL · HSG-GPE.B**

**CCSS.Math.Content.HSG-GPE.B** "Use coordinates to prove simple geometric theorems algebraically"

NAME _____ DATE _____

## PROVE IT WITH SLOPE

For nonvertical lines, find slope with rise/run. Two distinct nonvertical lines are parallel exactly when their slopes are equal; equal slope and equal intercept describe the same line. Two distinct vertical lines are parallel. Nonvertical lines are perpendicular when their slopes multiply to -1. A vertical line and a horizontal line are perpendicular.

## WORKED EXAMPLE

Show that AB is parallel to CD. A(-13, 17), B(-9, 24), C(21, -8), and D(25, -1).

1. mAB = (24 - 17) / [-9 - (-13)] = 7/4
2. mCD = [-1 - (-8)] / (25 - 21) = 7/4
3. The slopes are equal.
4. Therefore, AB is parallel to CD.

**Answer: AB is parallel to CD.**

## PRACTICE 6 problems

**1** Are PQ and RS parallel? P(-4, 2), Q(2, 5), R(0, -3), and S(6, 0). Show the slopes.

**ANSWER** _____

**2** Are EF and GH perpendicular? E(-3, 4), F(1, 2), G(0, 5), and H(2, 1). Show the slopes.

**ANSWER** _____

**3** Find x so that AB is parallel to CD. A(-6, 0), B(2, 12), C(4, -4), and D(4 + x, 2).

**ANSWER** _____

**4** Find y so that MN is perpendicular to UV. M(-4, 2), N(2, 5), U(0, 7), and V(2, y).

**ANSWER** _____

**5** Triangle JKL has J(-2, -4), K(2, -2), and L(0, 2). Prove that the triangle is a right triangle. Name the vertex with the right angle.

**ANSWER** _____

**6** Prove that quadrilateral ABCD is a parallelogram. A(-4, -2), B(0, 1), C(4, -3), and D(0, -6).

**ANSWER** _____

## APPLY IT Show your work

**1** A skate park designer places one rail from (-6, 0) to (2, 4). A second rail goes from (1, 7) to (3, 3). Are the rails perpendicular? Use slopes to prove your answer.

WORK SPACE

**ANSWER**

**2** A student council designs a photo booth floor with corners E(-2, 1), F(4, 4), G(6, 0), and H(0, -3). Does the floor form a parallelogram? Use slopes to prove your answer.

WORK SPACE

**ANSWER**

## CHALLENGE One step up

Quadrilateral ABCD has A(-2, 1), B(4, 4), C(6, y), and D(0, -3). Find y so that ABCD is a rectangle. Explain using slopes.

WORK SPACE AND ANSWER

**ANSWER KEY**

# Slope Proof Lab

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## PART 1 · PRACTICE

| # | PROBLEM | ANSWER |
|---|---|---|
| 1 | Are PQ and RS parallel? P(-4, 2), Q(2, 5), R(0, -3), and S(6, 0). Show the slopes. | **Yes. mPQ = 1/2 and mRS = 1/2, so PQ is parallel to RS.** |
| 2 | Are EF and GH perpendicular? E(-3, 4), F(1, 2), G(0, 5), and H(2, 1). Show the slopes. | **No. mEF=-1/2 and mGH=-2. Their product is +1, not -1, so EF and GH are not perpendicular.** |
| 3 | Find x so that AB is parallel to CD. A(-6, 0), B(2, 12), C(4, -4), and D(4 + x, 2). | **x=4** |
| 4 | Find y so that MN is perpendicular to UV. M(-4, 2), N(2, 5), U(0, 7), and V(2, y). | **y=3** |
| 5 | Triangle JKL has J(-2, -4), K(2, -2), and L(0, 2). Prove that the triangle is a right triangle. Name the vertex with the right angle. | **mJK = 1/2 and mKL = -2. Since the slopes are negative reciprocals, angle K is a right angle.** |
| 6 | Prove that quadrilateral ABCD is a parallelogram. A(-4, -2), B(0, 1), C(4, -3), and D(0, -6). | **mAB = 3/4 and mCD = 3/4. mBC = -1 and mAD = -1. Both pairs of opposite sides are parallel, so ABCD is a parallelogram.** |

## PART 2 · APPLY IT

1. **Yes. The rails are perpendicular.** The first rail has slope 1/2. The second rail has slope -2, which is the negative reciprocal of 1/2.
2. **Yes. EFGH is a parallelogram.** mEF = 1/2 and mGH = 1/2. Also, mFG = -2 and mHE = -2, so both pairs of opposite sides are parallel.

## CHALLENGE

**y = 0. Then mAB = 1/2, mBC = -2, mCD = 1/2, and mDA = -2. Opposite sides are parallel, and adjacent sides are perpendicular, so ABCD is a rectangle.**

Accept correctly simplified equivalent slopes, such as 3/6 for 1/2. For perpendicular claims, accept either negative reciprocal reasoning or a correct demonstration that the slopes multiply to -1 when both slopes are defined. Parallel-line claims require distinct supporting lines. Equal slope alone also permits coincident lines; check different intercepts or an off-line point. Handle vertical and horizontal lines separately.