Parallel and Perpendicular Lines

Geometry Worksheet · Grade 8–10

Name: _____ Date: _____

Learning Objectives

- Apply the Parallel Postulate and Perpendicular Postulate to identify unique parallel and perpendicular lines through a given point
- Use the Perpendicular Transversal Theorem to determine relationships between lines cut by a transversal
- Apply the Two Lines Parallel to a Third Line Theorem to prove lines are parallel

Problems

1. The Parallel Postulate states that through a point not on a line, how many lines can be drawn parallel to that given line?

2. The Perpendicular Postulate states that through a point not on a line, how many lines can be drawn perpendicular to that given line?

3. In algebra, if line a has a slope of 3, what is the slope of any line parallel to line a?

$$m_{\parallel} = 3$$

4. In algebra, if line b has a slope of 4, what is the slope of any line perpendicular to line b?

$$m_{\perp} = -\frac{1}{4}$$

5. If line l is parallel to line m, and transversal t is perpendicular to line l, what is the relationship between transversal t and line m?

$$l \parallel m,\ t \perp l \Rightarrow t \perp m$$

6. Line a is parallel to line b, and line b is parallel to line c. What can you conclude about lines a and c?

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$$a \parallel b,\ b \parallel c \Rightarrow a \parallel c$$

7. Line p has equation y = -\frac{1}{2}x + 3. Write the equation of the line parallel to p that passes through the point (0, 7).

$$y = -\frac{1}{2}x + 7$$

8. Line q has equation y = 3x - 5. Write the equation of the line perpendicular to q that passes through the point (0, 2).

$$y = -\frac{1}{3}x + 2$$

9. In a two-column proof, given that l ■ m and t ⊥ l, provide the correct theorem or postulate that justifies the conclusion t ⊥ m as a reason in the proof.

$$l \parallel m,\ t \perp l \Rightarrow t \perp m$$

10. Write a two-column proof: Given that line a ■ line b, line b ■ line c, and transversal t ⊥ line a, prove that t ⊥ line c.

$$a \parallel b \parallel c,\ t \perp a \Rightarrow t \perp c$$

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Parallel and Perpendicular Lines — Answer Key

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Answer Key

1. Answer: Exactly one

- Recall the Parallel Postulate: through a point not on a line, there is one and only one line parallel to the given line.
- Therefore, exactly one parallel line can be drawn through the point.

2. Answer: Exactly one

- Recall the Perpendicular Postulate: through a point not on a line, there is one and only one line perpendicular to the given line.
- Therefore, exactly one perpendicular line can be drawn through the point.

3. Answer: 3

- Parallel lines have exactly the same slope.
- Since line a has slope 3, any line parallel to it also has slope 3.

4. Answer: -1/4

- Perpendicular lines have slopes that are negative reciprocals of each other.
- The negative reciprocal of 4 is -\frac{1}{4}, so the perpendicular slope is -\frac{1}{4}.

5. Answer: t is perpendicular to m

- Apply the Perpendicular Transversal Theorem: if a transversal is perpendicular to one of two parallel lines, it is perpendicular to the other.
- Since t ⊥ l and l ■ m, by the theorem t ⊥ m.

6. Answer: a is parallel to c

- Apply the Two Lines Parallel to a Third Line Theorem.
- If a ■ b and b ■ c, then a ■ c — all three lines are parallel to each other.

7. Answer: y = -1/2 x + 7

- Parallel lines share the same slope, so the new line also has slope -\frac{1}{2}.
- Using point-slope form with point (0, 7): y = -\frac{1}{2}x + 7.

8. Answer: y = -1/3 x + 2

- The slope of line q is 3; the perpendicular slope is the negative reciprocal: -\frac{1}{3}.
- Using the y-intercept of 2: y = -\frac{1}{3}x + 2.

9. Answer: Perpendicular Transversal Theorem

- The given information establishes l ■ m and t ⊥ l as statements in the proof.
- The Perpendicular Transversal Theorem justifies that t ⊥ m, since a transversal perpendicular to one of two parallel lines is perpendicular to the other.

10. Answer: t is perpendicular to c (by Perpendicular Transversal Theorem applied twice)

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- Statement 1: a ■ b | Reason: Given
- Statement 2: t ⊥ a | Reason: Given
- Statement 3: t ⊥ b | Reason: Perpendicular Transversal Theorem (t ⊥ a and a ■ b)
- Statement 4: b ■ c | Reason: Given
- Statement 5: t ⊥ c | Reason: Perpendicular Transversal Theorem (t ⊥ b and b ■ c)

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