E-LEARNING Day 2

Analyze slopes to determine whether lines are parallel, perpendicular, neither, or coincidental.

https://f1.apps.elf.edmentum.com/courseware-delivery/e/preview/45857803/1/

https://youtu.be/LrB6cQHFyJQ

1. Standard

Standard GS.PAFR.2.2: Analyze slopes of lines to determine whether lines are parallel, perpendicular, or neither. Address the occurrence of coincidental lines. Exploration of parallel and perpendicular lines outside their connection to shapes and transversals is a new concept for students.

Learning Objective:

By the end of this module, I will be able to

- Calculate slope from an equation, two points, a table, or a graph.
- Use slope relationships to classify two lines as parallel, perpendicular, neither, or coincidental.
- Explain why coincidental lines are not simply a different pair of parallel lines.
- Apply slope relationships to real-world and coordinate-plane situations.

2. Mini-Lesson

Key idea: The slope tells how a line rises or falls as x increases.

Relationship	Slope Rule	What It Means
Parallel	$m_1 = m_2$	Same steepness and direction; distinct lines do not intersect.
Perpendicular	$m_1m_2 = -1$	Slopes are negative reciprocals; lines meet at 90°.
Coincidental	$m_1 = m_2$ and same line	The equations represent

		exactly the same line.
Neither	Neither rule applies	The lines are not parallel, perpendicular, or the same line.

Slope formulas:

- From $y = mx + b$: slope = m.
- From two points (x_1, y_1) and (x_2, y_2): $m = (y_2 - y_1)/(x_2 - x_1)$.
- From a graph: slope = rise/run.
- Horizontal line: slope 0. Vertical line: slope is undefined.

3. Important Example: Coincidental Lines

The lines $y = 2x + 3$ and $2y = 4x + 6$ are coincidental.

Rewrite the second equation: $y = 2x + 3$.

Both equations describe the exact same set of points. Therefore, there are infinitely many intersection points—not one intersection point.

Compare this with parallel lines: $y = 2x + 3$ and $y = 2x - 5$ have the same slope but different y-intercepts, so they never intersect.

4. E-Learning Path

Engage — 5 min: Look at the visual above. Identify one example of parallel, perpendicular, and coincidental lines.

Learn — 15–20 min: Read the mini-lesson. Then use a graphing calculator such as Desmos/GeoGebra to graph pairs of equations.

Try — 15 min: Complete the worked examples below without looking at the answer key.

Practice — 25–30 min: Complete all 15 MCQs and 5 descriptive questions.

Reflect — 5 min: Explain in your own words how coincidental lines differ from parallel lines.

5. Guided Examples

Example A — Parallel: y = 3x + 2 and y = 3x − 7. Slopes are 3 and 3. Same slope, different intercepts → PARALLEL.

Example B — Perpendicular: y = 2x + 1 and y = −½x + 4. Product 2(−½) = −1 → PERPENDICULAR.

Example C — Coincidental: y = −4x + 6 and 2y = −8x + 12. Rewrite the second: y = −4x + 6 → COINCIDENTAL.

Example D — Neither: y = x + 1 and y = 2x + 3. Slopes are 1 and 2; product is 2 → NEITHER.

SC MATH LESSON PLAN

Standard: GS.PAFR.2.2

Analyze slopes of lines to determine whether lines are parallel, perpendicular, or neither.
Address the occurrence of coincidental lines.

Exploration of parallel and perpendicular lines outside of its connection to shapes and transversals is a new concept for students.

Grade Level: 9–10

Topic: Analyze Slopes of Lines

Time: 60 minutes (Self-Learning / E-Learning)

Learning Mode: Self-Paced / Asynchronous

LEARNING OBJECTIVES

Students will be able to:

- Calculate the slope of a line from an equation, table, or graph.
- Use slopes to determine whether two lines are parallel, perpendicular, or neither.
- Identify coincidental lines.
- Justify conclusions using slope relationships.

MATERIALS / RESOURCES

- Internet access / Learning Management System
- Notebook or digital notes
- Calculator
- Desmos / GeoGebra (optional)
- Video lesson (see resources)
- Worksheet (attached)

LESSON OVERVIEW (SELF LEARNING / E LEARNING)

1 ENGAGE – 5 min

- Think: How can the slope of a line tell us about its relationship to another line?
- Real-world connection: Railroad tracks are parallel. A wall and the floor are perpendicular.

2 LEARN – 20 min

Watch a short video or read the lesson notes.

Key Ideas:

- Slope (m) tells us the steepness and direction of a line.
- Parallel lines have the same slope.
- Perpendicular lines have slopes that are negative reciprocals.
- Coincidental lines are the same line (infinite solutions).

Slope Rules

Relationship	Slope Condition
Parallel	$m_1 = m_2$ (and $b_1 \neq b_2$)
Perpendicular	$m_1 \cdot m_2 = -1$
Coincidental	$m_1 = m_2$ and $b_1 = b_2$

Ways to find slope:

- From equation $y = mx + b$ → slope is m
- From two points $(x_1, y_1), (x_2, y_2)$ → $m = \frac{y_2 - y_1}{x_2 - x_1}$
- From graph → $rise/run$
- From table → $\Delta y/\Delta x$

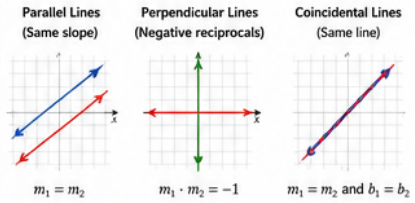
3 PRACTICE – 20 min

- Complete the attached worksheet (15 MCQs and 5 descriptive questions).
- Check your answers using the solution guide.

4 REFLECT – 10 min

- Why do parallel lines have the same slope?
- Why do perpendicular lines have slopes that are negative reciprocals?
- How are coincidental lines different from parallel lines?

VISUAL REMINDERS



EXTENSION / ENRICHMENT

- Use Desmos to graph two lines and change slopes to explore relationships.
- Real-life: Roads on a map, building ramps, and engineering designs.

Assessment: Worksheet (15 MCQs + 5 Descriptive)

Mastery: I can analyze slopes to classify lines as parallel, perpendicular, neither, or coincidental.

GS.PAFR.2.2 PRACTICE WORKSHEET

Analyze slopes of lines to determine whether lines are parallel, perpendicular, or neither. Address the occurrence of coincidental lines.

PART A: MULTIPLE CHOICE QUESTIONS (15)

Choose the best answer.

1. What is the slope of the line $y = 4x - 7$?
   A. 4 B. −4 C. 7 D. -7

2. What is the slope of the line passing through $(2, 3)$ and $(6, 11)$?
   A. 2 B. −2 C. 1 D. 4

3. Which equation has a slope of $-\frac{3}{5}$?
   A. $y = -\frac{3}{5}x + 2$ B. $y = \frac{5}{3}x - 2$
   C. $y = -\frac{5}{3}x + 1$ D. $y = \frac{3}{5}x + 1$

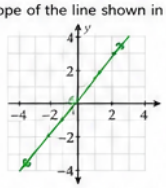
4. The slope of l_1 is 2. The slope of l_2 is 2.
   What is the relationship between l_1 and l_2?
   A. Parallel B. Perpendicular
   C. Coincidental D. Neither

5. The slopes of two lines are 3 and $-\frac{1}{3}$.
   The lines are:
   A. Parallel B. Perpendicular
   C. Coincidental D. Neither

6. Which pair of lines is perpendicular?
   A. $y = 2x + 1$ and $y = -2x + 3$
   B. $y = 3x - 4$ and $y = \frac{1}{3}x + 2$
   C. $y = -3x + 1$ and $y = 3x - 1$
   D. $y = 4x$ and $y = 4x - 7$

7. Which pair of lines is parallel?
   A. $y = -2x + 5$ and $y = -2x - 1$
   B. $y = 2x + 1$ and $y = -2x + 3$
   C. $y = 3x - 4$ and $y = \frac{1}{3}x + 2$
   D. $y = x + 1$ and $y = -x + 1$

8. What is the slope of the line shown in the graph?
   A. 2
   B. $\frac{1}{2}$
   C. -2
   D. $-\frac{1}{2}$



9. Which line is coincidental with $y = 2x + 1$?
   A. $y = 2x - 1$ B. $2y = 4x + 2$
   C. $y = -2x + 1$ D. $y = 2x + 2$

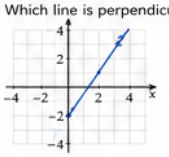
10. If $m_1 = 5$, what must m_2 be for the two lines to be perpendicular?
    A. $\frac{1}{5}$ B. $-\frac{1}{5}$ C. -5 D. 5

11. Which statement is true about coincidental lines?
    A. Same slope, different y-intercept
    B. Same slope and same y-intercept
    C. Slopes are negative reciprocals
    D. Slopes are equal in magnitude

12. What is the slope of a horizontal line?
    A. 0 B. 1 C. undefined D. -1

13. What is the slope of a vertical line?
    A. 0 B. 1 C. undefined D. -1

14. Which line is perpendicular to the line shown?



    A. $y = -3x + 1$
    B. $y = \frac{1}{3}x + 1$
    C. $y = -\frac{1}{3}x + 1$
    D. $y = 3x + 1$

15. The line $y = -\frac{1}{2}x + 4$ is:
    A. Parallel to $y = -\frac{1}{2}x - 3$
    B. Perpendicular to $y = -2x + 4$
    C. Coincidental with $y = -\frac{1}{2}x + 4$
    D. Neither with $y = 2x + 4$

PART B: DESCRIPTIVE QUESTIONS (5)

1. Find the slope of the line passing through $(-3, 1)$ and $(5, 9)$.
2. Determine whether the lines are parallel, perpendicular, or neither.
   $y = 3x - 2$ and $y = 3x + 7$
3. Determine whether the lines are parallel, perpendicular, or neither.
   $y = -4x + 1$ and $y = x + 6$
4. $y = -\frac{2}{3}x + 5$ and $2y = -\frac{4}{3}x + 10$
5. Write the equation of a line that is perpendicular to $y = \frac{2}{3}x - 4$ and passes through the point $(6, -2)$.

ANSWER KEY
(Provided separately for self-check)

GS.PAFR.2.2 PRACTICE WORKSHEET

Name: _____ Date: _____ Class: _____

Directions: Choose the best answer for Part A. Show work for Part B.

Part A — Multiple Choice (15 Questions)

1. What is the slope of $y = 4x - 7$?

- A. 4
- B. −4
- C. 7
- D. −7

2. Find the slope of the line through (2, 3) and (6, 11).

- A. 2
- B. −2
- C. 1
- D. 4

3. Which equation has slope $-3/5$?

- A. $y = -3/5x + 2$
- B. $y = 5/3x - 2$
- C. $y = -5/3x + 1$
- D. $y = 3/5x + 1$

4. Line l_1 has slope 2 and line l_2 has slope 2. If their y-intercepts are different, what is the relationship?

- A. Parallel
- B. Perpendicular
- C. Coincidental
- D. Neither

5. The slopes of two lines are 3 and $-1/3$. The lines are:

- A. Parallel
- B. Perpendicular
- C. Coincidental
- D. Neither

6. Which pair of lines is perpendicular?

- A. $y = 2x + 1$ and $y = -2x + 3$
- B. $y = 3x - 4$ and $y = 1/3x + 2$
- C. $y = -3x + 1$ and $y = 1/3x - 1$
- D. $y = 4x + 1$ and $y = 4x - 7$

7. Which pair of lines is parallel?

- A. $y = -2x + 5$ and $y = -2x - 1$
- B. $y = 2x + 1$ and $y = -2x + 3$
- C. $y = 3x - 4$ and $y = 1/3x + 2$
- D. $y = x + 1$ and $y = -x + 1$

8. What is the slope of a line passing through $(-2, -4)$ and $(2, 4)$?

- A. 2
- B. $1/2$
- C. -2
- D. $-1/2$

9. Which line is coincidental with $y = 2x + 1$?

- A. $y = 2x - 1$
- B. $y = 4x + 2$
- C. $y = -2x + 1$
- D. $y = 2x + 1$

10. If $m_1 = 5$, what must m_2 be for the lines to be perpendicular?

- A. $1/5$
- B. $-1/5$
- C. -5
- D. 5

11. Which statement is true about coincidental lines?

- A. Same slope, different y-intercept
- B. Same slope and same y-intercept
- C. Slopes are negative reciprocals
- D. Slopes are equal in magnitude only

12. What is the slope of a horizontal line?

- A. 0
- B. 1
- C. Undefined
- D. −1

13. What is the slope of a vertical line?

- A. 0
- B. 1
- C. Undefined
- D. −1

14. Which equation is perpendicular to $y = -3x + 2$?

- A. $y = -1/3x + 1$
- B. $y = 1/3x + 1$
- C. $y = -3x + 1$
- D. $y = 3x + 1$

15. The line $y = -1/2x + 4$ is:

- A. Parallel to $y = -1/2x - 3$
- B. Perpendicular to $y = -2x + 4$
- C. Coincidental with $y = -1/2x + 4$
- D. Neither with $y = 2x + 4$

Part B — Descriptive / Constructed Response (5)

1. Find the slope of the line passing through (−3, 1) and (5, 9). Show the formula and substitution.

Work: _____

_____

2. Determine whether $y = 3x - 2$ and $y = 3x + 7$ are parallel, perpendicular, neither, or coincidental. Explain.

Work: _____

_____

3. Determine whether $y = -4x + 1$ and $y = x + 6$ are parallel, perpendicular, neither, or coincidental. Explain.

Work: _____

_____

4. Determine the relationship between $y = -2/3x + 5$ and $2y = -4/3x + 10$. Show why the answer is not simply 'parallel.'

Work: _____

_____

5. Write the equation of a line perpendicular to $y = 2/3x - 4$ that passes through $(6, -2)$. Show your reasoning.

Work: _____

_____