E-Learning Lesson Plan Day 3

Standard

GS.PAFR.2.3: Determine the equation of a line passing through a given point that is parallel or perpendicular to a given line.

Use the slope-intercept form of a linear equation.

Solve geometric and real-world situations involving lines and slopes.

https://youtu.be/8Hxf2emeNqg

Learning Objectives

- Find slope and y-intercept.
- Write a line parallel to a given line through a point.
- Write a line perpendicular to a given line through a point.
- Use y = mx + b to find the unknown y-intercept.
- Apply line equations to geometry and real-world situations.

Essential Ideas & Formula Reference

Relationship	Slope	Strategy
Parallel	same slope	Use m, then substitute the given point to find b.
Perpendicular	negative reciprocal	Change sign and flip the fraction; then find b.

Slope-intercept form: $y = mx + b$. For a line through (x_1,y_1), substitute the point into $y = mx + b$ after choosing the required slope.

E-Learning Sequence

Engage — 5 min: Study the road/ramp diagrams. Identify examples of parallel paths and right-angle intersections.

Learn — 15–20 min: Review slope-intercept form and the parallel/perpendicular slope rules.

Explore — 10 min: Graph the original and new lines in Desmos/GeoGebra. Move the point and observe the change in b.

Practice — 25–30 min: Complete 15 MCQs and 5 descriptive problems; show work.

Reflect — 5 min: Explain why parallel lines keep the same slope and perpendicular lines use a negative reciprocal.

Worked Examples

Parallel: Given $y = 2x + 3$ and point $(1,-4)$. Use $m=2$: $-4=2(1)+b$, so $b=-6$. Answer: $y=2x-6$.

Perpendicular: Given $y = -3x + 5$ and point $(2,1)$. Perpendicular slope is $1/3$: $1=(1/3)(2)+b$, so $b=1/3$. Answer: $y=(1/3)x+1/3$.

Horizontal: A line parallel to $y=7$ has slope 0. Through $(3,-5)$: $y=-5$.

Vertical: A line perpendicular to a horizontal line is vertical. Through $(4,2)$: $x=4$. Vertical lines cannot be written in slope-intercept form.

Real-World Applications

- Road edges and lane markings can be modeled by parallel lines.
- Ramps can be modeled with slope as rise/run.
- Walls and floors often form perpendicular lines.
- Maps can use parallel routes and perpendicular boundaries.
- Engineering and architecture use line equations to model edges, supports, rails, and boundaries.

SC MATH LESSON PLAN & PRACTICE WORKSHEET

Standard: GS.PAFR.2.3

Determine the equation of a line passing through a given point that is parallel or perpendicular to a given line.
Use the slope-intercept form of a linear equation. Solve geometric and real-world situations involving lines and slopes.

Grade Level: 9–10 | **Time:** 60 minutes (Self-Learning / E-Learning) | **Learning Mode:** Self-Paced / Asynchronous | **Focus:** Lines, Slopes, Equations, Applications

LEARNING OBJECTIVES

You will be able to:

- Find the equation of a line parallel to a given line through a given point.
- Find the equation of a line perpendicular to a given line through a given point.
- Use slope-intercept form $y = mx + b$.
- Apply concepts to solve geometric and real-world problems.

ESSENTIAL IDEA

Parallel lines have the same slope. Perpendicular lines have slopes that are negative reciprocals.

MATERIALS / RESOURCES

- Notebook / Paper
- Pencil
- Calculator
- Internet / Learning Platform
- Desmos (optional)
- Worksheet (attached)

KEY VOCABULARY

- Slope (m)
- Parallel lines
- Perpendicular lines
- y-intercept (b)
- Slope-intercept form: $y = mx + b$

LESSON PLAN (SELF LEARNING / E LEARNING)

1. ENGAGE – 5 min

Think about roads on a map.

- Two roads going in the same direction? → Parallel
- Cross at a right angle? → Perpendicular

How can we write equations for these roads (lines)? Let's learn!

Parallel Roads



Perpendicular Roads



2. LEARN – 20 min

Slope-Intercept Form of a Line: $y = mx + b$

where m = slope, b = y-intercept (value of y when $x = 0$).

Parallel Lines

Parallel lines have the SAME slope.
If the given line has slope m and the line must pass through (x_1, y_1), then the equation is:

$$y - y_1 = m(x - x_1)$$

or

$y = mx + b$ (find b using the point)

Perpendicular Lines

Perpendicular lines have slopes that are NEGATIVE RECIPROCALS.
If the given line has slope m, then the perpendicular slope is $-\frac{1}{m}$.
If the line must pass through (x_1, y_1), then the equation is:

$$y - y_1 = -\frac{1}{m}(x - x_1)$$

or

$y = -\frac{1}{m}x + b$ (find b using the point)

Examples:

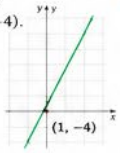
1 Find the equation of the line parallel to $y = 2x + 3$ that passes through $(1, -4)$.

Slope $m = 2$

Use $y - (-4) = 2(x - 1)$

$y + 4 = 2x - 2$

$\boxed{y = 2x - 6}$



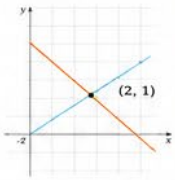
2 Find the equation of the line perpendicular to $y = -3x + 5$ that passes through $(2, 1)$.

Slope $m = -3$ → Perpendicular slope $= \frac{1}{3}$

Use $y - 1 = \frac{1}{3}(x - 2)$

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

$\boxed{y = \frac{1}{3}x + \frac{1}{3}}$



3. PRACTICE – 20 min

Complete the worksheet (15 MCQs + 5 Descriptive Questions).

Use notes, examples, and a calculator if needed.

4. REFLECT – 10 min

- How did you find the slope of each line?
- Why do parallel lines have the same slope?
- Why are perpendicular slopes negative reciprocals?
- Where do you see lines and slopes in real life?

FORMULA QUICK REFERENCE

Slope of a line:	$m = \frac{y_2 - y_1}{x_2 - x_1}$
Parallel slope:	$m_{parallel} = m$
Perpendicular slope:	$m_{perp} = -\frac{1}{m}$
Point-slope form:	$y - y_1 = m(x - x_1)$
Slope-intercept form:	$y = mx + b$

Assessment: Worksheet (15 MCQs + 5 Descriptive) **Mastery:** I can write equations of lines parallel or perpendicular to a given line through a point and apply them to solve problems.

PRACTICE WORKSHEET – GS.PAFR.2.3

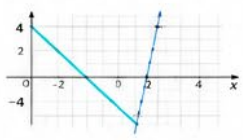
PART A: MULTIPLE CHOICE QUESTIONS (15)

Choose the best answer.

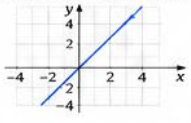
1. What is the equation of the line parallel to $y = 3x - 2$ that passes through $(2, 5)$?
   A. $y = 3x - 1$ B. $y = 3x - 2$ C. $y = 3x - 7$ D. $y = -\frac{1}{3}x + 5$
2. What is the equation of the line perpendicular to $y = 2x + 7$ that passes through $(4, -1)$?
   A. $y = -\frac{1}{2}x + 1$ B. $y = -\frac{1}{2}x + 3$ C. $y = \frac{1}{2}x - 1$ D. $y = \frac{1}{2}x - 3$
3. A line has slope -4. The slope of any line perpendicular to it is:
   A. -4 B. 4 C. $\frac{1}{4}$ D. $-\frac{1}{4}$
4. What is the equation of the line parallel to $y = -\frac{1}{2}x + 4$ that passes through $(6, 8)$?
   A. $y = -\frac{1}{2}x + 11$ B. $y = -\frac{1}{2}x + 5$ C. $y = -\frac{1}{2}x + 2$ D. $y = 2x - 4$
5. What is the equation of the line perpendicular to $y = \frac{2}{3}x - 1$ that passes through $(-3, 2)$?
   A. $y = -\frac{3}{2}x - \frac{5}{2}$ B. $y = -\frac{3}{2}x - \frac{5}{2}$ C. $y = \frac{3}{2}x - \frac{5}{2}$ D. $y = \frac{3}{2}x + \frac{5}{2}$
6. Find the equation of the line parallel to $y = x + 9$ that passes through $(0, -3)$.
   A. $y = x - 3$ B. $y = x + 3$ C. $y = -x - 3$ D. $y = -x + 3$
7. Find the equation of the line perpendicular to $y = -5x + 2$ that passes through $(1, 4)$.
   A. $y = \frac{1}{5}x + \frac{19}{5}$ B. $y = \frac{1}{5}x + \frac{21}{5}$ C. $y = -\frac{1}{5}x + \frac{19}{5}$ D. $y = -\frac{1}{5}x + \frac{21}{5}$
8. If a line is parallel to $y = -2x + 7$, which of the following points could it pass through and have y-intercept -1?
   A. $(0, -1)$ B. $(1, -1)$ C. $(2, -1)$ D. $(3, -1)$
9. A line perpendicular to $y = \frac{1}{4}x + 6$ passes through $(4, 0)$. What is its equation?
   A. $y = -4x + 16$ B. $y = -4x + 12$ C. $y = 4x - 16$ D. $y = 4x + 16$
10. Which equation represents a line parallel to $y = 7$ and passing through $(3, -5)$?
    A. $y = -5$ B. $y = 7$ C. $x = 3$ D. $y = 3$
11. A line is perpendicular to $y = -\frac{3}{5}x + 1$ and passes through $(-5, 2)$. What is the equation?
    A. $y = \frac{5}{3}x + \frac{31}{3}$ B. $y = \frac{5}{3}x - \frac{19}{3}$ C. $y = -\frac{5}{3}x + \frac{31}{3}$ D. $y = -\frac{5}{3}x - \frac{19}{3}$
12. What is the slope of the line perpendicular to $y = -\frac{2}{3}x + 8$?
    A. $-\frac{2}{3}$ B. $\frac{3}{2}$ C. $-\frac{3}{2}$ D. $\frac{2}{3}$
13. Find the equation of the line parallel to $y = 5x - 4$ that passes through $(-2, 6)$.
    A. $y = 5x + 16$ B. $y = 5x - 4$ C. $y = 5x + 4$ D. $y = -5x + 6$
14. Which of the following pairs of lines are perpendicular?
    A. $y = 2x + 1$ and $y = -\frac{1}{2}x + 3$
    B. $y = 2x + 1$ and $y = 2x - 4$
    C. $y = -3x + 1$ and $y = -\frac{1}{3}x - 2$
    D. $y = 4x + 5$ and $y = 4x - 1$
15. A ladder makes a $60°$ angle with the ground. If the ladder passes through $(0, 0)$ and its top touches a wall at $(5, h)$, which equation models the ladder?
    A. $y = \sqrt{3}x$ B. $y = -\sqrt{3}x$ C. $y = \frac{1}{\sqrt{3}}x$ D. $y = -\frac{1}{\sqrt{3}}x$

PART B: DESCRIPTIVE QUESTIONS (5)

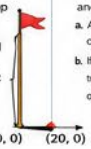
1. Write the equation of the line parallel to $y = -\frac{2}{3}x + 5$ that passes through $(3, -1)$. Show your work.



3. The graph below shows a road.
   A new road is planned to be parallel to this road and pass through the point $(2, -4)$.
   a. What is the equation of the existing road?
   b. What is the equation of the new road?



4. A flagpole casts a shadow. At one time, the top of the flagpole is $(0, 15)$ feet and the shadow tip is $(20, 0)$ feet.
   a. Write the equation of the line that represents the top of the flagpole and the shadow tip.
   b. A second pole is perpendicular to the first pole and passes through $(5, 5)$. Write its equation.



5. Two train tracks are represented by lines $y = \frac{1}{2}x + 3$ and $2x + 4y = 8$.
   a. Are the tracks parallel, perpendicular, or neither?
   b. If a service road must be perpendicular to the first track and pass through $(4, 1)$, what is the equation of the service road?

ANSWER KEY (Provided separately for self-check) 🙂

EXTENSION / ENRICHMENT

- Use Desmos to graph the given line and the new line.
- Find real-world examples (roofs, ramps, ladders, railroads).
- Challenge: Create your own real-world problem involving slopes.

GS.PAFR.2.3 PRACTICE WORKSHEET

Name: _____ Date: _____ Class: _____

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

1. What is the equation of the line parallel to y = 3x − 2 that passes through (2,5)?

- A. $y=3x-1$
- B. $y=3x+2$
- C. $y=3x-7$
- D. $y=-3x+5$

2. What is the equation of the line perpendicular to y = 2x + 7 that passes through (4,−1)?

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

3. A line has slope −4. The slope of a perpendicular line is:

- A. −4
- B. 4
- C. $1/4$
- D. $-1/4$

4. What is the equation parallel to y = −1/2x + 4 through (6,8)?

- A. $y=-1/2x+11$
- B. $y=-1/2x+5$

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

5. What is the equation perpendicular to $y = 2/3x - 1$ through $(4,-2)$?

- A. $y=-3/2x+4$
- B. $y=-3/2x-8$
- C. $y=3/2x-8$
- D. $y=2/3x-2$

6. Find the line parallel to $y=x+9$ through $(0,-3)$.

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

7. Find the line perpendicular to $y=-5x+2$ through $(1,4)$.

- A. $y=1/5x+19/5$
- B. $y=-1/5x+21/5$
- C. $y=5x-1$
- D. $y=-5x+9$

8. If a line is parallel to $y=-2x+7$ and has y-intercept -1, which point lies on it?

- A. $(0,-1)$
- B. $(1,-1)$
- C. $(2,-1)$
- D. $(-1,-1)$

9. A line perpendicular to $y=1/4x+6$ passes through $(4,0)$.

- A. $y=-4x+16$
- B. $y=-4x+12$
- C. $y=4x-16$
- D. $y=1/4x-1$

10. Which equation is parallel to $y=7$ and passes through $(3,-5)$?

- A. $y=-5$
- B. $y=7$
- C. $x=3$
- D. $y=3$

11. A line perpendicular to $y=-3/5x+1$ passes through $(-5,2)$.

- A. $y=5/3x+31/3$
- B. $y=5/3x+19/3$
- C. $y=-5/3x+31/3$
- D. $y=-3/5x-1$

12. What is the slope perpendicular to $y=-2/3x+8$?

- A. $-2/3$
- B. $3/2$
- C. $-3/2$
- D. $2/3$

13. Find the line parallel to $y=5x-4$ through $(-2,6)$.

- A. $y=5x+16$
- B. $y=5x-6$
- C. $y=5x+4$
- D. $y=-5x-4$

14. Which pair is perpendicular?

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

15. A ladder and a vertical wall meet at a right angle. The wall and ground are best modeled as:

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

Part B — Descriptive / Constructed Response (5)

1. Write the equation parallel to $y = -2/3x + 5$ through $(3,-1)$. Show how you find b.

Work:

_____

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2. Write the equation perpendicular to $y = 4x - 7$ through $(-2,3)$. Show all steps.

Work:

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3. A road is y = 1/2x − 2. A new road must be parallel and pass through (4,5). Find its equation and explain the equal slopes.

Work:

_____

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4. A flagpole is x = 6. Write an equation for a line perpendicular to the flagpole through (2,4). Explain the slope.

Work:

_____

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5. Tracks are 2x + 4y = 8 and 2x + 4y = 4. Classify them. Then find a line perpendicular to the first track through (4,1).

Work:

_____

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