

## Problem-Based Task: Pave the Way

### Coaching Sample Responses

- a. What is the equation of the line that represents the center of the road?

The equation of the center of the road is  $y = \frac{3}{5}x + 5$  as stated in the problem.

- b. What is the slope of the equation that represents the center of the road?

The slope of the equation representing the center is  $\frac{3}{5}$ .

- c. What is the slope of the lines that represent each edge of the road? How do you know?

The slope of each edge is  $\frac{3}{5}$ . The edges of the road are parallel to the center of the road.

Lines that are parallel to one another have the same slope.

- d. Which point represents the edge of one side of the road?

One edge of the road is marked by the point (16, 1).

- e. What is the equation that represents this edge of the road?

Substitute the slope of the given line for  $m$  in the point-slope form of a linear equation.

$$y - y_1 = m(x - x_1) \quad \text{Point-slope form}$$

$$y - y_1 = \frac{3}{5}(x - x_1) \quad \text{Substitute } \frac{3}{5} \text{ for } m.$$

Substitute  $x$  and  $y$  from the given point into the equation for  $x_1$  and  $y_1$ .

$$y - y_1 = \frac{3}{5}(x - x_1) \quad \text{Equation}$$

$$y - 1 = \frac{3}{5}(x - 16) \quad \text{The given point is (16, 1). Substitute 16 for } x_1 \text{ and 1 for } y_1.$$

Simplify the equation.

$$y - 1 = \frac{3}{5}(x - 16) \quad \text{Equation with substituted values for } x_1 \text{ and } y_1$$

$$y - 1 = \frac{3}{5}x - \frac{48}{5} \quad \text{Distribute } \frac{3}{5} \text{ over } (x - 16).$$

$$y = \frac{3}{5}x - \frac{43}{5} \quad \text{Add 1 to both sides.}$$

The equation of the line through the point (16, 1) that is parallel to the equation  $y = \frac{3}{5}x + 5$  is

$$y = \frac{3}{5}x - \frac{43}{5}.$$

- f. Which point represents the other edge of the road?

The other edge of the road is marked by the point (4, 21).

- g. What is the equation that represents this edge of the road?

Substitute the slope of the given line for  $m$  in the point-slope form of a linear equation.

$$y - y_1 = m(x - x_1) \quad \text{Point-slope form}$$

$$y - y_1 = \frac{3}{5}(x - x_1) \quad \text{Substitute } \frac{3}{5} \text{ for } m.$$

Substitute  $x$  and  $y$  from the given point into the equation for  $x_1$  and  $y_1$ .

$$y - y_1 = \frac{3}{5}(x - x_1) \quad \text{Equation}$$

$$y - 21 = \frac{3}{5}(x - 4) \quad \text{The given point is (4, 21). Substitute 4 for } x_1 \text{ and 21 for } y_1.$$

Simplify the equation.

$$y - 21 = \frac{3}{5}(x - 4) \quad \text{Equation with substituted values for } x_1 \text{ and } y_1$$

$$y - 21 = \frac{3}{5}x - \frac{12}{5} \quad \text{Distribute } \frac{3}{5} \text{ over } (x - 4).$$

$$y = \frac{3}{5}x + \frac{93}{5} \quad \text{Add 21 to both sides.}$$

The equation of the line through the point (4, 21) that is parallel to the equation  $y = \frac{3}{5}x + 5$  is

$$y = \frac{3}{5}x + \frac{93}{5}.$$

- h. What is the minimum distance for a two-lane road?

The minimum distance for a two-lane road is 24 feet.

- i. What formula is used to calculate the distance between points?

The distance formula,  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ , is used to calculate the distance between two points.

- j. What are the two points that are directly across the road from each other?

The two points are (16, 1) and (4, 21).

- k. What is the distance between these two points?

$$\begin{aligned}
 d &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} && \text{Distance formula} \\
 &= \sqrt{(4 - 16)^2 + (21 - 1)^2} && \text{Substitute the points (16, 1) and (4, 21).} \\
 &= \sqrt{(-12)^2 + (20)^2} && \text{Simplify.} \\
 &= \sqrt{144 + 400} && \text{Evaluate squares.} \\
 &= \sqrt{544} && \text{Simplify.}
 \end{aligned}$$

The distance between the points (6, 1) and (4, 21) is  $\sqrt{544}$  feet, which is approximately 23 feet.

- l. Does the placement of the points meet the minimum distance requirement?

The minimum distance requirement is 24 feet.

The placement of the points does not meet the minimum distance requirement. The distance is too short.

### Recommended Closure Activity

Select one or more of the essential questions for a class discussion or as a journal entry prompt.