Performance Based Learning and Assessment Task

Linear Equations in Real Word Problems

I.   ASSESSSMENT TASK OVERVIEW & PURPOSE:
In this activity, students will explore the linear relationships present in real life word problems. Given a graph and two points, students will analyze a line to determine the domain, range, slope, intercepts and slope-intercept equation for the line. Students will then create a word problem that fits their line and points, explaining what the slope and y-intercept represent in their function.

II.   UNIT AUTHOR:
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III.   COURSE:
Algebra I

IV.   CONTENT STRAND:
Equations and Inequalities

V.   OBJECTIVES:
The learner will be able to create a real life word problem based on the analysis of a given line and two points on that line. Students will also describe what the slope and y-intercept represents in their real life word problem.

VI.   REFERENCE/RESOURCE MATERIALS:
Students will need a copy of the given graphs and worksheet guiding the analysis of the line and creation of a word problem. Graphing calculators and interactive software (Geogebra or Desmos) can also be utilized as a way for students to test their equations and extend their thinking.

VII.   PRIMARY ASSESSMENT STRATEGIES:
Students will be assessed on their ability to analyze a given line and create a real world word problem that is modeled by that line. Students will have a checklist that can be used for self-evaluation, teacher evaluation and teacher feedback.

VIII.   EVALUATION CRITERIA:
The Evaluation Form and benchmarks of exemplary work are included in the lesson plan.

IX.   INSTRUCTIONAL TIME:
One 90 minute block, after students have been instructed on the basics of linear equations including range, domain, slope, intercepts and slope-intercept equations for a line.

Linear Equations in Real World Problems

Strand

Algebra I, Equations and Inequalities

Mathematical Objective(s)

After completing this activity, learners will be able to create a real life word problem based on a given graph of a linear equation and two included points. Learners will also calculate and explain the slope for a given line, describe the range and domain, and identify the intercepts.

Related SOL

- A.6 The student will graph linear equations and linear inequalities in two variables, including
    - a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as a rate of change and will be positive, negative, zero, or undefined; and
    - b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

NCTM Standards

- Understand patterns, relations and functions.
- Represent and analyze mathematical situations and structures using algebraic symbols
- Use mathematical models to represent and understand quantitative relationships
- Analyze change in various contexts.

Materials/Resources

Students will need a copy of the given graphs and worksheet guiding the analysis of the line and creation of a word problem. Graphing calculators and interactive software (Geogebra, Desmos) can also be utilized as a way for students to test their equations and extend their thinking.

Assumption of Prior Knowledge

- Students should be able to plot points, graph a line and provide appropriate axis labels.
- Students should be able to describe range and domain.
- Students should be able to calculate slope by looking at the graph of a line or by using given coordinates.
- Students should be able to determine the intercepts for a given graph.
- Students should be able to write the equation of a line based on the slope and y- intercept.
- Students should be able to use appropriate vocabulary when discussing slope and what it represents.
- Students should be able to use appropriate vocabulary when discussing a y-intercept and what it represents.
- Students should be able to relate slope and y-intercepts to real life rates of change and starting points.

Introduction: Setting Up the Mathematical Task

- In this activity, students will analyze a given line and create a real life word problem that can be modeled by that line.
- This activity can be completed in one 90 minute block, after initial instruction on range, domain, slope, intercepts, equations of lines and graphing.
- The activity can be introduced as a challenge to students. Explain that the students will be given a line that models a real life relationship, and it will be their job to come up with a word problem that can be described by the given line.

- Also explain that students will need to analyze their line to make connections between the slope, intercepts, range, and domain while creating their real life word problem.
- Students should be grouped in pairs to work cooperatively as they analyze the given points and line.
- Students will make their mathematical thinking and understanding public through their analysis of the given graphs and the completion of their checklist.

Student Exploration
After an introduction to the activity, the teacher will put students into pairs and pass out necessary materials for analysis.
Small Group Work (Partners)
- Students will analyze the given graph and points to complete an initial investigation of range, domain, intercepts, slope and slope-intercept equation for their line.
- Once students analyze their graph, they will determine a real life situation that can be modeled by the given line.
- Students will then create their own word problem that can be represented by the given line.
- The final step for each problem will require the students to explain what their slope and y-intercept represent in their word problem.

Whole Class Sharing/Discussion
- Students can share their word problems with the whole class, demonstrating all of the different ways a single line can be used to model a real life situation.
- Student can also discuss the word problems that they abandoned because they did not fit the given model of the linear relationship.

Student/Teacher Actions
- Students will be analyzing a given graph and set of points.
- Students will be determining range, domain, slope, intercepts and the equation for a line.
- Students will be creating a real life situation that can be modeled by a predetermined, given line.
- Teachers should be monitoring student progress, making sure that the students are moving on to each step in the activity. They may need to redirect students to the task at hand, ask guiding questions to help move students along, or help settle misunderstandings.
- Teachers can extend this activity by incorporating the use of graphing calculators or graphing software that allows students to test their calculations.

Monitoring Student Responses
- Students will communicate their thinking and new knowledge through the discussions they have with their partners, the analysis of their graphs, the creation of a real life word problem, and the completion of the checklist.
- Students will communicate with each other during partner work time and in whole group discussions
- Clarification can be achieved through discussions with a partner and teacher prompts.
- Students who have difficulty can work through their difficulties by talking through the graphs and analysis with their partner or seeking the assistance of the teacher.
- Teachers can extend the activity by having students write their own real world problems (without a graph), and having another student create the graph to determine if the word problem was as clear and concise as possible.
- The activity can be summarized in a whole group activity where students group share their word problems and discuss any misconceptions they had to overcome.
- Teachers may want to post the two graphs in the classroom and have each group of students share their word problem, allowing the other students to decide which graph the word problem is modeled after.
- Evidence of student's knowledge can be gathered by analyzing the students' work, listening to their conversations with their partners, and in completion of their checklist.

Assessment List and Benchmarks

- Student work habits for this PBA include an understanding an application of basic vocabulary associated with lines, and creating a real life word problem that can be modeled by a given line.
- Student Worksheet 1: Linear Equations in Real World Problems, two pages, guided questions for students to complete. Includes graphs to analyze and charts to complete as part of the analysis of the essential mathematics including range, domain, slope, intercepts and equation for a line.
- Student Worksheet 2: Linear Equations in Real World Problems Checklist, one page, rubric for students to self-assess their work, making sure all performance components of the PBA have been addressed.
- Benchmark: Hypothetical student work for Worksheet 1
- Feedback can be provided informally as students are working with their partner and formally on the provided checklist.

Linear Equations in Real World Problems   Name _____

1. Given the following graph and set of points, complete the included analysis.
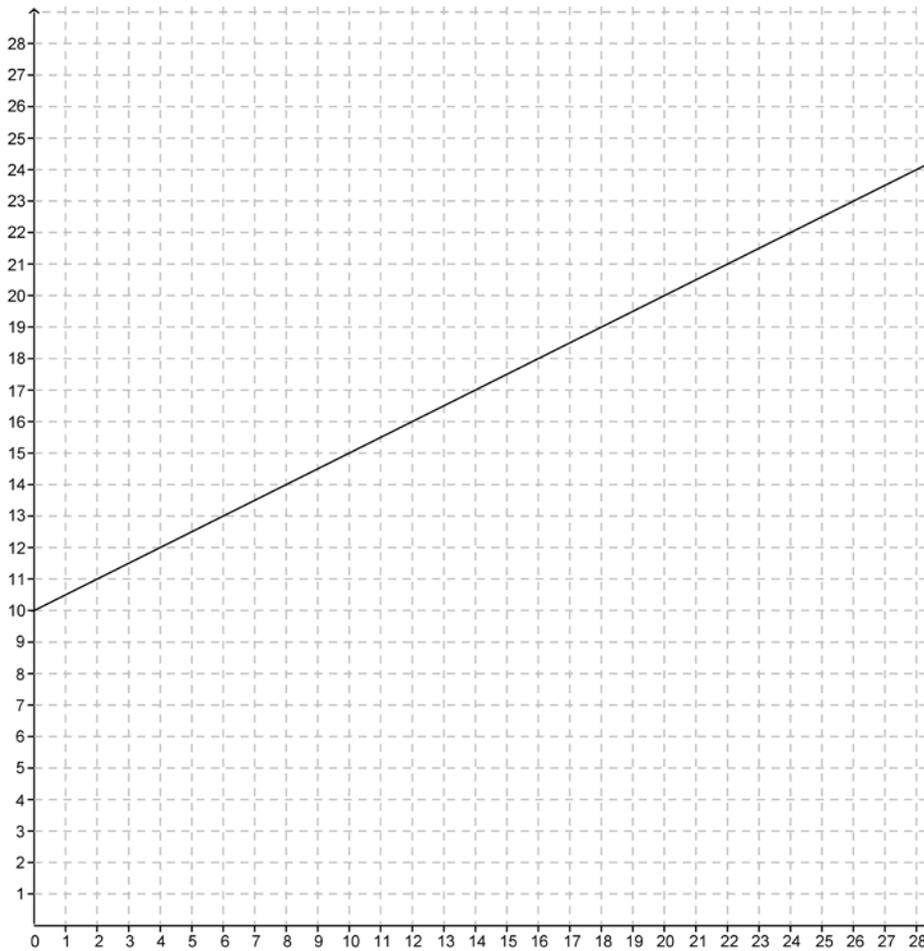
Range	
Domain	
Slope	
y-intercept	
x-intercept	
Slope-intercept equation	

The line contains points (4, 12) and (9, 14.50).

2. Based on your above answers, create a word problem that can be modeled by the graph. Explain what the slope and y-intercept represent.

3. Given the following graph and set of points, complete the included analysis.
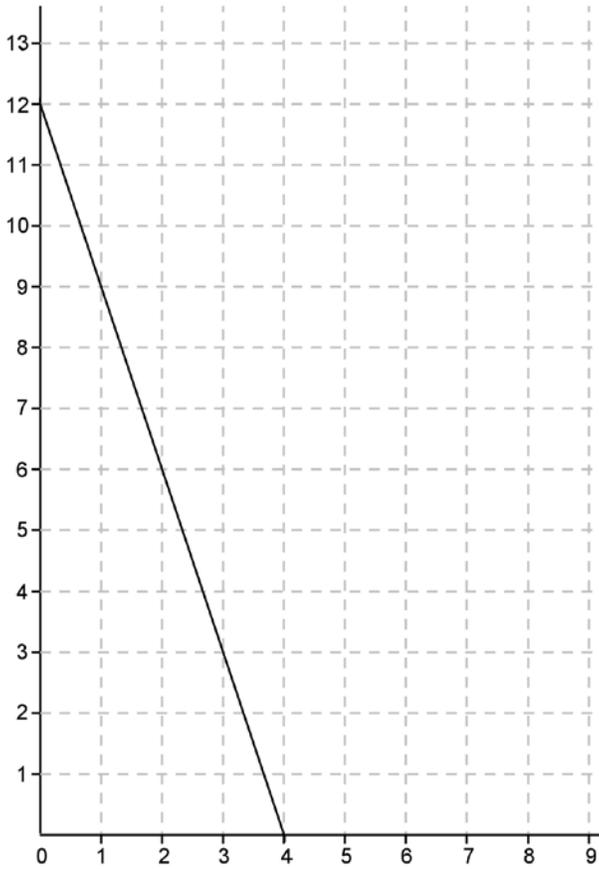
The line contains points (0, 12) and (1, 9).

Range	
Domain	
Slope	
y-intercept	
x-intercept	
Slope-intercept equation	

4. Based on your above answers, create a word problem that can be modeled by the graph. Explain what the slope and y-intercept represent.

Linear Equations in Real World Problems
Checklist

Name _____

For Graph 1:

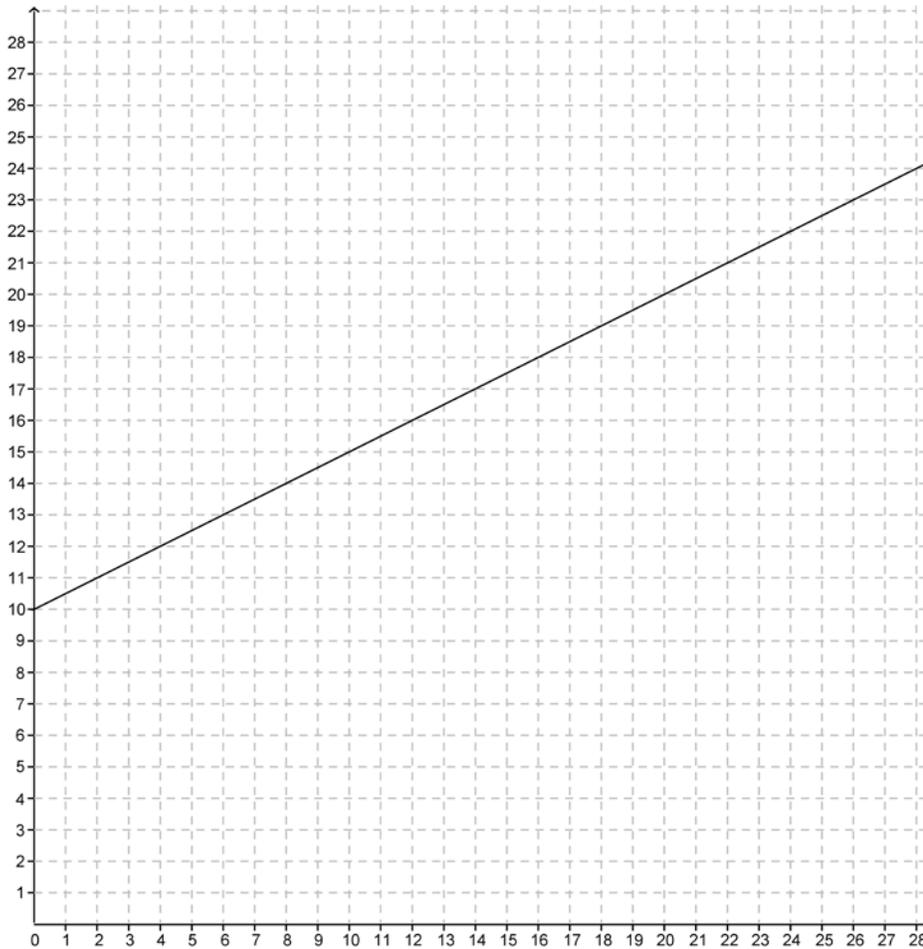| Question	Student Score	Teacher Score
Did I list the Range? (1 point)		
Did I list the Domain? (1 point)		
Did I list the slope? (1 point)		
Did I list the y-intercept? (1 point)		
Did I list the x-intercept? (1 point		
Did I write the slope-intercept equation? (1 point)		
Did I create a real world problem that could be modeled by the graph? (10 points)		
Did I explain what is represented by the slope? (2 points)		
Did I explain what is represented by the y-intercept? (2 points)		
Total	/20	/20

For Graph 2:

Question	Student Score	Teacher Score
Did I list the Range? (1 point)		
Did I list the Domain? (1 point)		
Did I list the slope? (1 point)		
Did I list the y-intercept? (1 point)		
Did I list the x-intercept? (1 point		
Did I write the slope-intercept equation? (1 point)		
Did I create a real world problem that could be modeled by the graph? (10 points)		
Did I explain what is represented by the slope? (2 points)		
Did I explain what is represented by the y-intercept? (2 points)		
Total	/20	/20

Comments:

Linear Equations in Real World Problems

Name _____

1. Given the following partial graph and set of points, complete the included analysis.

Range	All y ≥ 10
Domain	All x ≥ 0
Slope	$\frac{1}{2}$
y-intercept	10
x-intercept	None for displayed graph, but -20 for function
Slope-intercept equation	y = .5x + 10

The line contains points (4, 12) and (9, 14.50).

2. Based on your above answers, create a word problem that can be modeled by the graph. Explain what the slope and y-intercept represent.

Gretchen plans on taking her dog to doggy day care. When she called to get information, the doggy day care center explained their prices, saying they charge $10 plus $.50 an hour. When Gretchen asked about 4 hours, she was told it would be $12, when she asked about 9 hours, she was told it would be $14.50.

The slope represents the cost per hour (50 cents) of doggy day care.

The y-intercept represents the initial charge of $10 for doggy day care.

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3. Given the following partial graph and set of points, complete the included analysis.
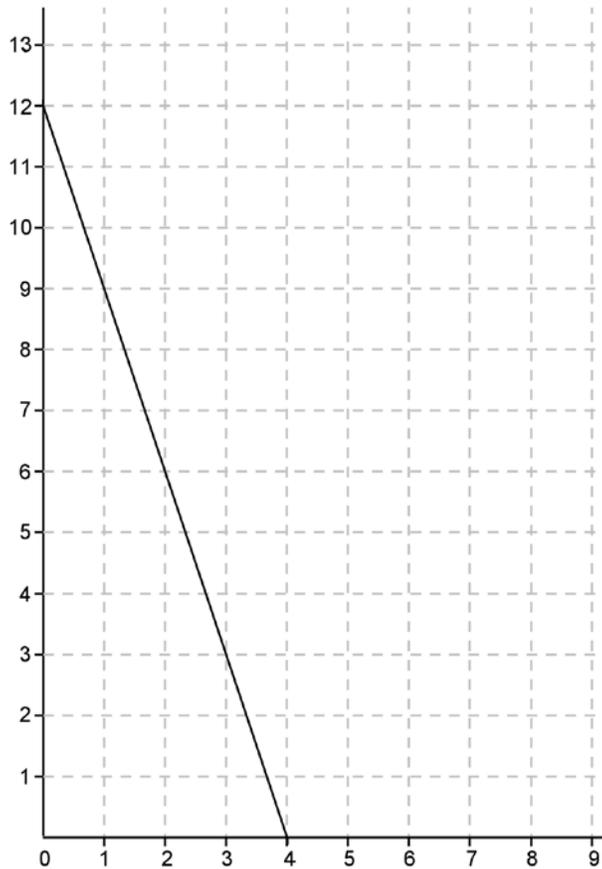
Range	$0 \leq y \leq 12$
Domain	$0 \leq x \leq 4$
Slope	$\dfrac{-3}{1}$
y-intercept	12
x-intercept	4
Slope-intercept equation	y = -3x +12

The line contains points (0, 12) and (1, 9).

4. Based on your above answers, create a word problem that can be modeled by the graph. Explain what the slope and y-intercept represent.

Gretchen decided to go hiking one afternoon. She parked her car and set out towards a cabin she had rented. At the start of her hike, Gretchen was 12 miles away from the cabin, one hour later she was 9 miles away.

The slope represents how many miles per hour she is traveling from the car to the cabin.

The y-intercept represents the initial distance (12 miles) Gretchen was from her rented cabin.