Inspect

CCR Performance Task

Math Grade 8: Using Linear Functions

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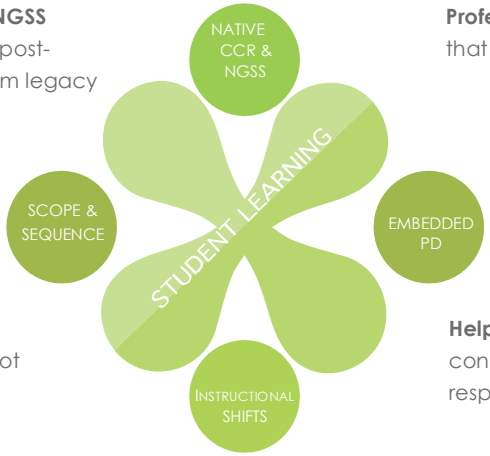

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CCR Performance Tasks

Math Grade 8: Using Linear Functions

Student Test Booklet

Name:

_____

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Student Rubric

This problem is meant to test if you can:
- Use linear equations that model real-world situations.
- Analyze and solve linear equations and pairs of simultaneous linear equations.
- Interpret slopes of linear equations in terms of real-world situations.

Your teacher will rate your answer as a level 4, 3, 2, 1, or 0. The descriptions below explain the types of answers expected at each level.

Level 4:
Your answer is correct and complete.
Your answer includes:
- A correct equation based on data from a table and a formula, with a correct graph of that equation;
- A correct solution to a problem relating two functions with a correct and complete explanation of how you solved the problem;
- A correct interpretation of the slopes of equations, with a complete analysis of the variables involved.

Level 3:
Your answer is correct but one or two of your explanations are incomplete or you have made minor calculation mistakes.
Your answer includes:
- A correct equation and an accurate graph that contains no more than two minor errors;
- A correct solution to a problem relating two functions with an incomplete explanation of how you solved the problem;
- A correct interpretation of the slopes of equations, with an incomplete analysis of the variables involved.

Level 2:
You have answered one part correctly but your explanations are missing or weak.
Your answer includes:
- An equation that is correct or contains one or two minor errors and a graph that contains several minor errors;
- A partially correct solution to a problem relating two functions with an analysis that is incorrect or incomplete;
- A partially correct interpretation of the slopes of equations.

Level 1:
Your answers are incorrect.
Your answer includes:
- An incorrect equation and graph with several major errors;
- An incorrect solution to the problem relating two functions;
- An incorrect interpretation of the slopes of equations.

Level 0:
Your answer is not related to the question, the teacher cannot understand your answer, or you do not write anything.

Name:_____

Grade 8: Using Linear Functions

Complete all the tasks in the test booklet.

1 **There are many factors that help determine the number of calories a person's body burns while performing various activities. The type of activity, the amount of time spent performing the activity, and the person's weight are three of these factors. Physiologists have calculated Metabolic Equivalent (MET) values that tell you the amount of energy burned with different physical activities. The table below lists several different activities along with their corresponding (MET) values.**

Activity	MET Value
Playing Baseball	5.0
Playing Basketball	8.0
Dancing	4.8
Running	11.0
Playing Soccer	10.0
Playing Tennis	7.0
Playing Volleyball	4.0
Walking Briskly	5.0

The following equation can be used to approximate the number of calories that an individual burns:

$$C = \frac{(MET) \times (w)}{125} \times t$$

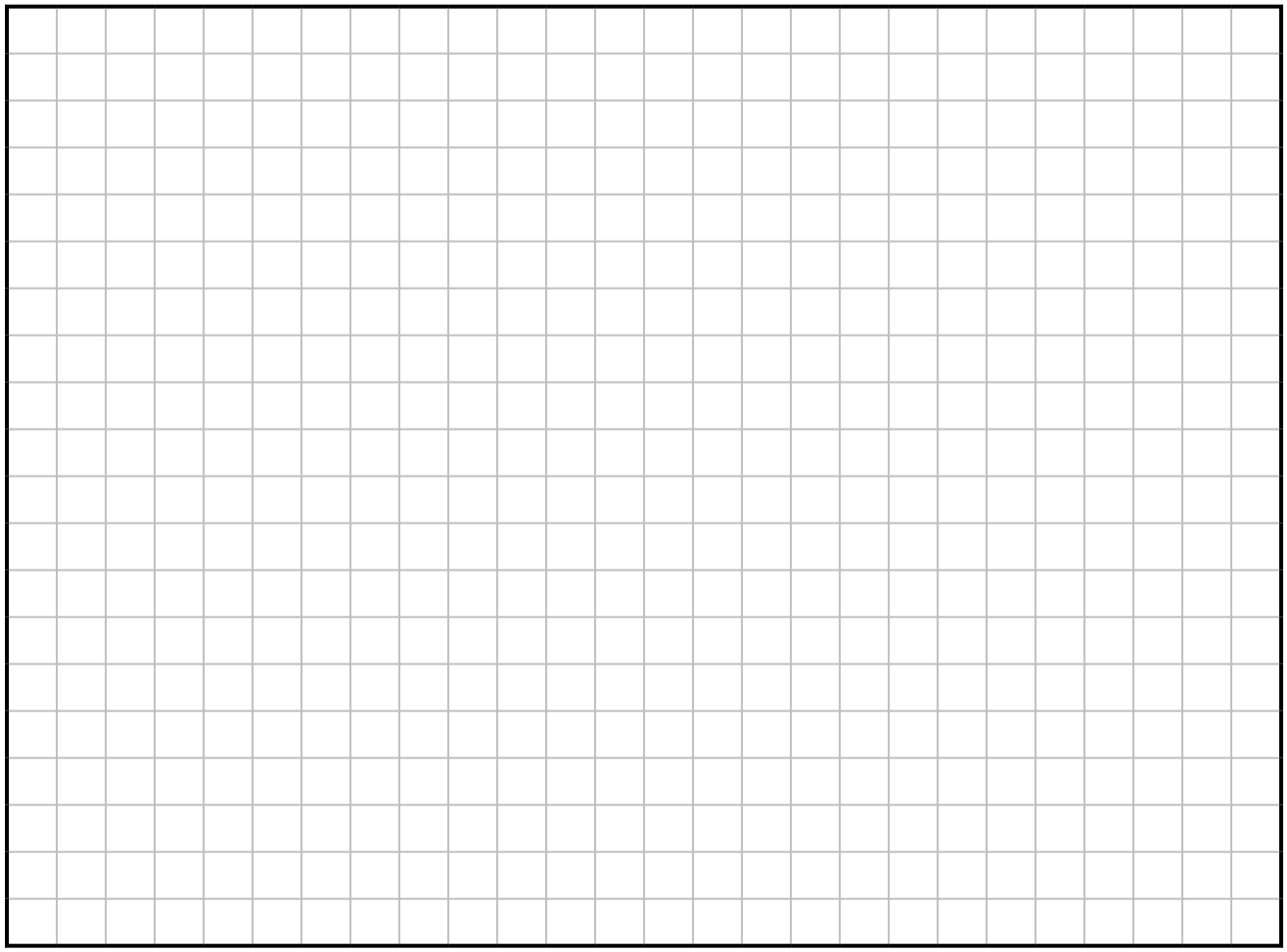
In this formula, C = the energy burned in calories, which are sometimes also called "Calories," "large calories," or "kilocalories," but in the context of nutrition, are usually referred to just as "calories." The other variables in the formula are MET = the Metabolic Equivalent value, w = weight of the person in pounds, and t = the time in minutes that the activity is performed.

Name:_____

Grade 8: Using Linear Functions

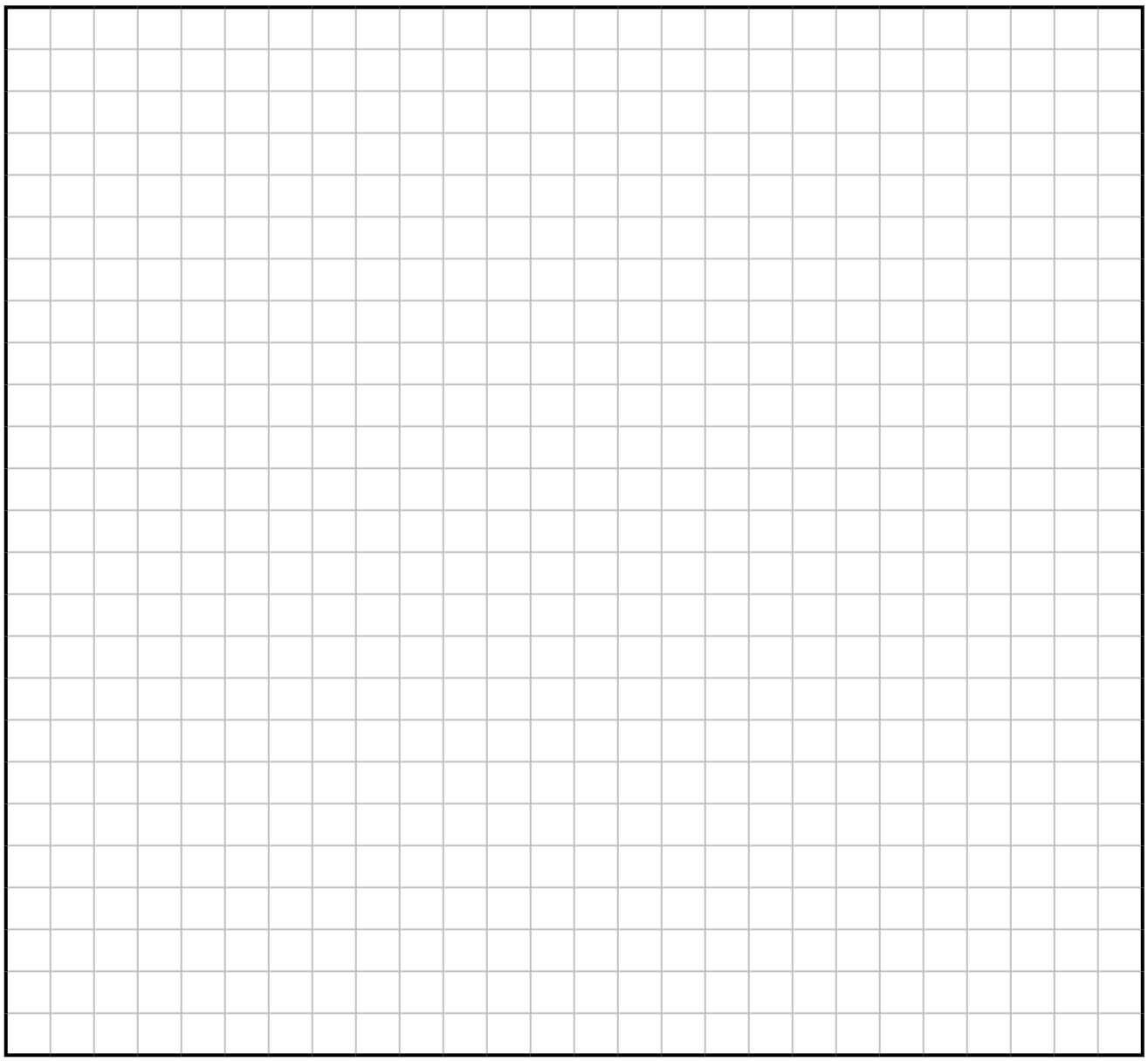
A. Some days, Cecilia both walks to her middle school and goes to physical education (P.E.) class. Cecilia weighs 125 pounds, and it takes Cecilia 12 minutes to walk briskly to her school every day. Today her P.E. class is playing volleyball.

- **Use the formula to calculate the number of calories Cecilia burns walking to school.**
- **Write and graph the equation that shows the total number of calories Cecilia burns walking to school and playing volleyball today, in terms of the number of minutes she spends playing volleyball.**



Name:_____

B. Cecilia's older bother goes to high school and takes the bus every day. His first class of the day is also P.E. Today his class is playing soccer. He weighs 150 lbs. How long does he have to play soccer before he has burned more calories than Cecilia has burned walking and then playing volleyball for the same amount of time? Explain how you arrived at your answer.



C. Cecilia plays volleyball for 45 minutes and her brother plays soccer for 35 minutes. If neither child gets any more physical activity during the school day, who has burned more calories AFTER Cecilia walks back home after school? Show your work and explain how you arrived at your answer.

D. You graphed some different equations to represent the number of calories burned by Cecilia and her brother. What does the rate of increase of the graphs (the slopes of the lines) represent in terms of calories burned? Explain which variables the slopes of the lines depend on.

CCR Performance Tasks

Math Grade 8: Using Linear Functions

Teacher Guide

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About the Teacher Guide

This document contains support materials for “Math Grade 8: Using Linear Functions.” This includes:

(a) The task
(b) The standards and depth of knowledge level of the task
(c) The scoring rubric
(d) Discussion questions
(e) Extension activities

These specifications have been included to help you connect the task to the common core content standards and the standards for mathematical practice. The rubric is designed to help you look for the development of mathematical practices in student work. It is also here to help you look for consistencies in student content errors that can help guide intervention and re-teach strategies.

Test Definition File

Item #	Correct Answer	Practice Standard	Content Standards
1	See Scoring Rubric	Mathematical Practice 4	8.EE.5, 8.EE.7.b, 8.EE.8.a, 8.EE.8 c

SBAC Claims	PARCC Sub-Claims
1 and 4	A and D

Performance Task

There are many factors that help determine the number of calories a person's body burns while performing various activities. The type of activity, the amount of time spent performing the activity, and the person's weight are three of these factors. Physiologists have calculated Metabolic Equivalent (MET) values that tell you the amount of energy burned with different physical activities. The table below lists several different activities along with their corresponding (MET) values.

Activity	MET Value
Playing Baseball	5.0
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Playing Volleyball	4.0
Walking Briskly	5.0

The following equation can be used to approximate the number of calories that an individual burns:

$$C = \frac{(MET) \times (w)}{125} \times t$$

In this formula, C = the energy burned in calories, which are sometimes also called "Calories," "large calories," or "kilocalories," but in the context of nutrition, are usually referred to just as "calories." The other variables in the formula are MET = the Metabolic Equivalent value, w = weight of the person in pounds, and t = the time in minutes that the activity is performed.

A. Some days, Cecilia both walks to her middle school and goes to physical education (P.E.) class. Cecilia weighs 125 pounds, and it takes Cecilia 12 minutes to walk briskly to her school every day. Today her P.E. class is playing volleyball.

- **Use the formula to calculate the number of calories Cecilia burns walking to school.**
- **Write and graph the equation that shows the total number of calories Cecilia burns walking to school and playing volleyball today, in terms of the number of minutes she spends playing volleyball.**

B. Cecilia's older bother goes to high school and takes the bus every day. His first class of the day is also P.E. Today his class is playing soccer. He weighs 150 lbs. How long does he have to play soccer before he has burned more calories than Cecilia has burned walking and then playing volleyball for the same amount of time? Explain how you arrived at your answer.

C. Cecilia plays volleyball for 45 minutes and her brother plays soccer for 35 minutes. If neither child gets any more physical activity during the school day, who has burned more calories AFTER Cecilia walks back home after school? Show your work and explain how you arrived at your answer.

D. You graphed some different equations to represent the number of calories burned by Cecilia and her brother. What does the rate of increase of the graphs (the slopes of the lines) represent in terms of calories burned? Explain which variables the slopes of the lines depend on.

Standards Alignment

Practice Standards

MP4 > DOK 3

Model with mathematics. -- Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

Content Standards

8.EE.5

Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*

8.EE.7.b

Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

8.EE.8.a

Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

8.EE.8.c

Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*

SBAC Claims

Mathematics Claim #1:
Concepts and Procedures. Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.

Mathematics Claim #4:
Modeling and Data Analysis. Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

PARCC Sub-Claims:

Sub-Claim A:
Major Content with Connections to Practices. The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.

Sub-Claim D:
Highlighted Practice MP.4 with Connections to Content: modeling/application.
The student solves real-world problems with a degree of difficulty appropriate to the grade/course by applying knowledge and skills articulated in the standards for the current grade/course (or, for more complex problems, knowledge and skills articulated in the standards for previous grades/courses), engaging particularly in the Modeling practice, and where helpful making sense of problems and persevering to solve them (MP.1), reasoning abstractly and quantitatively (MP.2), using appropriate tools strategically (MP.5), looking for and making use of structure (MP.7), and/or looking for and expressing regularity in repeated reasoning (MP.8).

Scoring Rubric

4 Point Response:
The response demonstrates a high level of understanding. A level 4 response is characterized by:

- The ability to create linear equations in order to model different situations;
- A strong understanding of how to solve individual equations and a pair of linear equations algebraically or graphically;
- The ability to interpret the slope of a linear equation in terms of real-world variables.

A level 4 response should include:

- The creation of the correct equations and corresponding graphs, using the correct calculation of total calories for Cecilia's walking segment;
- The correct solution to the set of linear equations;
- The correct answer to the question of who burned more calories, with an explanation of how the answer was found;
- A correct interpretation of the slopes of the graphs and a correct identification of the variables on which the slope depends.

A sample level 4 response follows.

Part A:

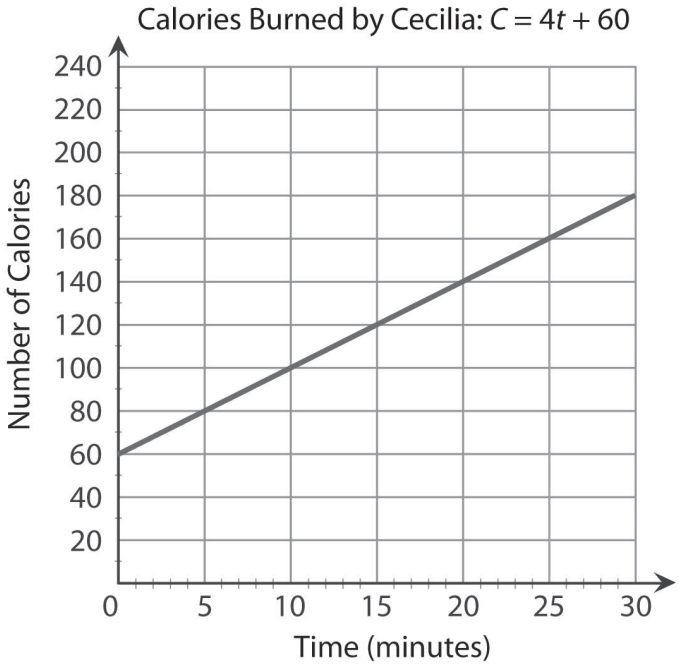
"The total number of calories that Cecilia burns walking to school is 60:

$$C = \frac{(MET) \times (w)}{125} \times t \rightarrow C = \frac{(5.0) \times (125)}{125} \times 12 \rightarrow C = 60$$

Now we need to find how many calories she burns playing volleyball. The table shows that the MET for volleyball is 4.0 and we know that Cecilia weighs 125 pounds. Plug these values into the equation and get

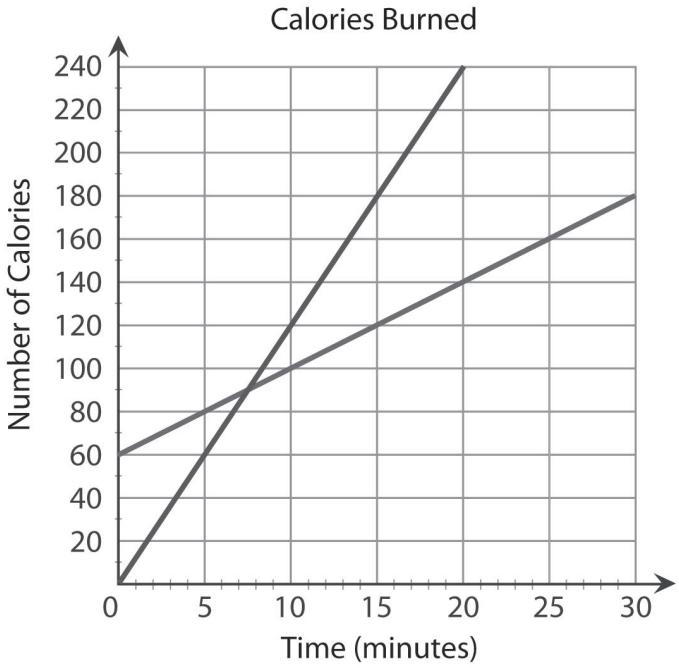
$$C = \frac{(4.0) \times (125)}{125} \times t \rightarrow C = 4t$$

We add in the 60 calories from walking to school and we get the equation $C = 4t + 60$."



Part B:

"The answer is 7.5 minutes. We have to find the equation of Cecilia's brother. Substituting her brother's values into $C = \frac{(MET) \times (w)}{125} \times t$, we get $C = \frac{(10.0) \times (150)}{125} \times t \rightarrow C = 12t$. If you graph this on the same graph as $C = 4t + 60$, you see that they intersect where $t = 7.5$. So, the answer is 7.5 minutes. Cecilia's brother burns more calories as long as they each play more than this amount of time.



Part C: “Cecilia’s brother burns more calories throughout the day. If you add up all of Cecilia’s burned calories, you get 60 from the walk to school, $C = \frac{(4.0) \times (125)}{125} \times 45$ or 180 from playing volleyball for 45 minutes, and another 60 for the walk home after school, for a total of 300 calories. Her brother plays soccer for 35 minutes, so his total calories burned is $C = \frac{(10.0) \times (150)}{125} \times 35$, or 420.”

Part D:

“The slopes of the graphs represent the number of calories burned per minute of activity. This number depends on the MET of the activity and the weight of the person performing the activity.”

3 Point Response:
The response demonstrates a strong understanding, but the work contains minor errors. A level 3 response is characterized by:

- The ability to create linear equations in order to model different situations, although each equation may contain a minor error;
- A strong understanding of how to solve individual and a pair of linear equations algebraically or graphically, although the explanations or graphs may be incomplete or partially incorrect;
- The ability to interpret the slope of a linear equation in terms of real-world variables, although the interpretation may be incomplete.

2 Point Response:

The response demonstrates a basic but incomplete understanding. A level 2 response is characterized by:

- A weak ability to create linear equations in order to model different situations, with equations that contain multiple minor errors;
- A weak understanding of how to solve individual and a pair of linear equations algebraically or graphically, with graphs and explanations that contain multiple errors and may be incomplete;
- A weak ability to interpret the slope of a linear equation in terms of real-world variables, with an interpretation that is partially correct.

1 Point Response:

The response demonstrates minimal understanding. A level 1 response is characterized by:

- A weak ability to create, interpret, and solve linear equations. The equations contain multiple errors and the explanations contain incorrect statements and demonstrate misconceptions about working with linear equations;
- A weak ability to graph linear equations;
- An inability to interpret the slope of a linear equation in terms of real-world variables, with an interpretation that is incorrect.

0 Point Response:

There is no response, or the response is off topic.

Discussion Questions

Use the following questions to help students struggling to access the problem:

1. Using the information given in this task, is it possible to calculate how long you need to play tennis in order to burn 400 calories?

Possible response: *Yes. I can use the equation and table provided. I substitute 400 for* C*, my weight for* w*, and 7.0 for* MET*, and solve for* t*. For example, a 150-pound man can use the following equation to find how long he needs to play tennis to burn 400 calories:* $400 = \frac{(7.0) \times (150)}{125} \times t$ *Solving for* t*, we find that it takes 47.6 minutes for a 150-pound man to burn 400 calories while playing tennis.*

2. Person A and person B each weigh the same. If person A takes part in an activity with a higher MET than person B, and they both perform the activities for the same amount of time, who burns more calories? Is this always true?

Possible response: *According to the equation provided, person A burns more calories because of the higher MET; this is always true if weight and time are the same.*

3. How does the given formula change if you want *t* to represent the time in hours?

Possible response: *The equation* $C = \frac{(MET) \times (w)}{125} \times t$ *works when t represents time in minutes. To change it so that* t *represents time in hours, we have to increase the right side of the equation by a factor of 60. Therefore, the equation becomes* $C = \frac{(MET) \times (w)}{125} \times t \times 60$ *or* $C = \frac{12 \times (MET) \times (w)}{25} \times t$.

Extension Activities

1. Extending understanding of rate of change (slope) for a linear equation that models a real-world situation.

   In part D of the task, you explained what the rate of increase (slope) of each equation represents, and what this rate depends on. What kinds of general conclusions about burning calories can you make? Under what conditions does someone burn more calories? Under what conditions does the person burn fewer calories?

2. Extending understanding of using a model with additional variables in a linear equation.

   The first column of the table below provides a scenario and some of its results. In the second column, please describe a situation that makes the information in the first column possible and explain your answer. Come up with a few scenarios of your own.

Scenario and Partial Results	**Description**
Person A burns more calories than person B. Both people weigh the same and exercise for the same amount of time.	
Person C burns more calories than person D. Person C plays volleyball. Person D plays soccer.	
Person E burns the same number of calories as Person F. Person E exercises for 30 minutes. Person F exercises for 15 minutes. Person E weighs more than person F.	

Sample Response:

Scenario and Partial Results	**Description**
Person A burns more calories than person B. Both people weigh the same and exercise for the same amount of time.	*Person A played basketball while person B played tennis. Since the weights and times are the same, the only thing that varies in the formula is the MET. As long as person A does an activity with a higher MET value than person B does, person A burns more calories.*
Person C burns more calories than person D. Person C plays volleyball. Person D plays soccer.	*If person C weighs 180 pounds and plays volleyball for 30 minutes, 172.8 calories are burned. If person D weighs 150 pounds and plays soccer for 10 minutes, then 120 calories are burned.*
Person E burns the same number of calories as Person F. Person E exercises for 30 minutes. Person F exercises for 15 minutes. Person E weighs more than person F.	*If person E weighs 100 pounds and dances for 30 minutes, then 115.2 calories are burned. Likewise, if person F weighs 96 pounds and plays soccer for 15 minutes, then 115.2 calories are burned.*