Grade 7 Target A

Domain, Target, Standards, DOK, Vertical Alignments, Achievement Levels, Evidence Required, Vocabulary, Response Types, Materials, Attributes, Question Types, and Question Banks (Examples)

Content Domain: Ratios and Proportional Relationships
Target A [m]: 7.RP.A Analyze proportional relationships and use them to solve real-world and mathematical problems.
Standards included in Target A: 7.RP.A, 7.RP.A.1, 7.RP.A.2, 7.RP.A.3
Vertical Alignment
Achievement Level Descriptors
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Vocabulary
Response Types
Materials
Attributes
Claim 1: Concepts and Procedures (DOK 2) Question Banks
Claim 2 Problem Solving Question Banks
Claim 3 Communicating Reasoning Question Banks
Claim 4 Modeling and Data Analysis Question Banks

Content Domain: Ratios and Proportional Relationships

Target A [m]: 7.RP.A Analyze proportional relationships and use them to solve real-world and mathematical problems.

Standards included in Target A: 7.RP.A, 7.RP.A.1, 7.RP.A.2, 7.RP.A.3

7.RP.A Analyze proportional relationships and use them to solve real-world and mathematical problems.

7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

c. Represent proportional relationships by equations. For example, if total cost t is

proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.
d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.

7.RP.A.3 Use proportional relationships to solve multi-step ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

Vertical Alignment

Related Grade 6 standards

6.RP.A Understand ratio concepts and use ratio reasoning to solve problems.

6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”

6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. For example, “This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar.” “We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger.”

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
b. Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?
c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

Related Grade 8 Standards

8.EE.B Reason about and solve one-variable equations and inequalities.

8.EE.B.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.

Achievement Level Descriptors

Level 1 Students should be able to identify proportional relationships presented in graphical, tabular, or verbal formats in familiar contexts.

Level 2 Students should be able to find whole number proportionality constants in relationships presented in graphical, tabular, or verbal formats in familiar contexts. They should also be able to identify proportional relationships presented in equation formats and find unit rates involving whole numbers.

Level 3 Students should be able to identify, represent, and analyze proportional relationships in various formats; find unit rates associated with ratios of fractions; and use unit rates to solve one-step problems involving rational numbers. They should be able to analyze a graph of a proportional relationship in order to explain what the points (x, y) and (1, r) represent, where r is the unit rate, and use this information to solve problems.

Level 4 Students should be able to solve real-world problems involving proportional relationships and measurement conversions in various formats (e.g., verbally, tabular, graphically) in a contextual scenario that involves identifying relationships between elements presented in various formats.

Evidence Required

1. The student computes unit rates and finds the constant of proportionality of proportional relationships in various forms.

2. The student determines whether two quantities, shown in various forms, are in a proportional relationship.

3. The student represents proportional relationships between quantities using equations.

4. The student interprets specific values from a proportional relationship in the context of a problem situation.

5. The student computes with percentages in context.

Vocabulary

proportional relationship, ratio, unit rate, constant of proportionality, origin, percent increase, percent decrease, percent error

Response Types

Equation/Numeric; Multiple Choice, multiple correct response; Matching Tables

Materials
two-way tables, graphs of both nonlinear and linear equations, equations in two variables, diagrams

Attributes
None

Claim 1: Concepts and Procedures (DOK 2) Question Banks
Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Claim 1 7.RP.A.1 & 7.RP.A.2b DOK Level 2

Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.

Recognize and represent proportional relationships between quantities. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

Evidence Required

The student computes unit rates and finds the constant of proportionality of proportional relationships in various forms.

Question Type 1: The student is presented with a verbal description of a real-world situation involving a proportional relationship.

1. David uses $\frac{1}{4}$ cup of apple juice for every $\frac{1}{2}$ cup of carrot juice to make a fruit drink.

Enter the number of cups of apple juice David uses for 1 cup of carrot juice.

Rubric: (1 point) The student enters the correct number (e.g., $\frac{1}{2}$).

Response Type: Equation/Numeric

Question Type 2: The student is presented with a table or diagram of a proportional relationship in a context.

1. This table shows a proportional relationship between the number of cups of sugar and flour used for a recipe.

Cups of Sugar	Cups of Flour
2	5
6	15
8	20

Enter the number of cups of sugar used for 1 cup of flour.

1. This table shows a proportional relationship between the number of cups of sugar and flour used for a recipe.

Cups of Sugar	Cups of Flour
$2\frac{1}{2}$	$7\frac{1}{2}$
$3\frac{3}{4}$	$11\frac{1}{4}$

Enter the number of cups of sugar used for 1 cup of flour.

Rubric: (1 point) Student enters the correct number (e.g., $\frac{2}{5}$; $\frac{1}{3}$).

Response Type: Equation/Numeric

Question Type 3: The student is presented with an equation of a proportional relationship.

1. A drink recipe calls for papaya juice and carrot juice. This equation represents the proportional relationship between the number of quarts of papaya juice (p) and carrot juice (c) in the recipe.

2p = 8c

Enter the number of quarts of papaya juice used for 1 quart of carrot juice.

2. A drink recipe calls for papaya juice and carrot juice. This equation represents the proportional relationship between the number of quarts of papaya juice (p) and carrot juice (c) in the recipe.

$$(1\frac{1}{3})p = (3\frac{1}{3})c$$

Enter the number of quarts of papaya juice used for 1 quart of carrot juice.

Rubric: (1 point) The student enters the correct number (e.g., 4; 5 2).

Response Type: Equation/Numeric

Claim 1 7.RP.A.2a DOK Level 2

Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.

Evidence Required

The student determines whether two quantities, shown in various forms, are in a proportional relationship.

Question Type 1: The student is presented with one table per answer choice. Where possible, include a contextual reason for the tables of relationships.

1. Select **all** tables that represent a proportional relationship between x and y.

A.

x	0	1	2	3
y	0	2	4	6

B.

x	0	2	4	6
y	0	4	16	36

C.

x	0	3	6	9
y	0	15	30	45

D.

x	0	4	6	8
y	0	16	36	64

Answer Choices: Answer choices should be tables showing a relationship between two quantities. There should be one to two tables showing proportional relationships. Distractors should be tables that do not show a proportional relationship, which may include a relationship following an equation in the form of y = mx + b (where b ≠ 0) or y = x2.

Rubric: (1 point) Student selects all the correct tables. (e.g., A and C).

Response Type: Multiple Choice, multiple correct response

2. Select **all** tables that represent a proportional relationship between x and y.

A.

x	0	1	2	3
y	0	2	4	6

B.

x	0	2	4	6
y	0	4	16	36

C.

x	0	$\frac{1}{9}$	$\frac{1}{4}$	$\frac{1}{2}$
y	0	$\frac{1}{81}$	$\frac{1}{16}$	$\frac{1}{4}$

D.

x	0	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{3}{3}$
y	0	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{3}{9}$

Answer Choices: Answer choices should be tables showing a relationship between two quantities. There should be one to two tables showing proportional relationships. Distractors should be tables that do not show a proportional relationship, which may include a relationship following an equation in the form of y = mx + b (where b ≠ 0) or y = x2.

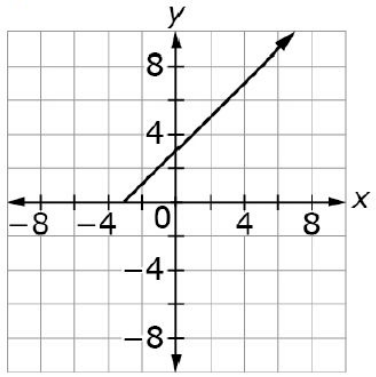
Rubric: (1 point) Student selects all the correct tables. (e.g., A and C).

Response Type: Multiple Choice, multiple correct response

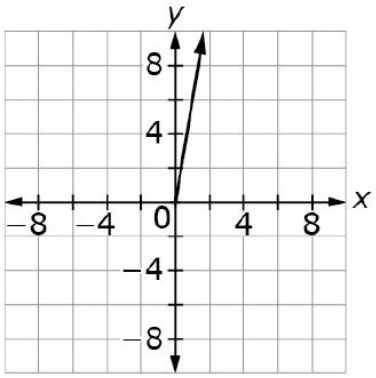
Question Type 2: The student is presented with one table or one graph per answer choice.

1. Select all the graphs that represent a proportional relationship between x and y.

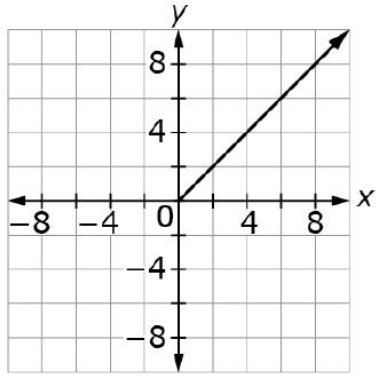
A)



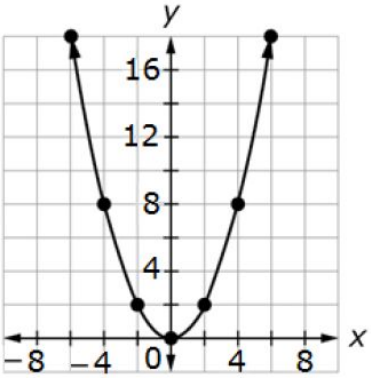
C)



B)



D)



Answer Choices: Distractors should be graphs that do not show a proportional relationship, which may show a nonlinear relationship or a relationship following an equation in the form of y = mx + b (where b ≠ 0) or y = x2.

Rubric: (1 point) Student selects all the correct graphs (e.g., B and C).

Response Type: Multiple Choice, multiple correct response

Claim 1 7.RP.A.2c DOK Level 2

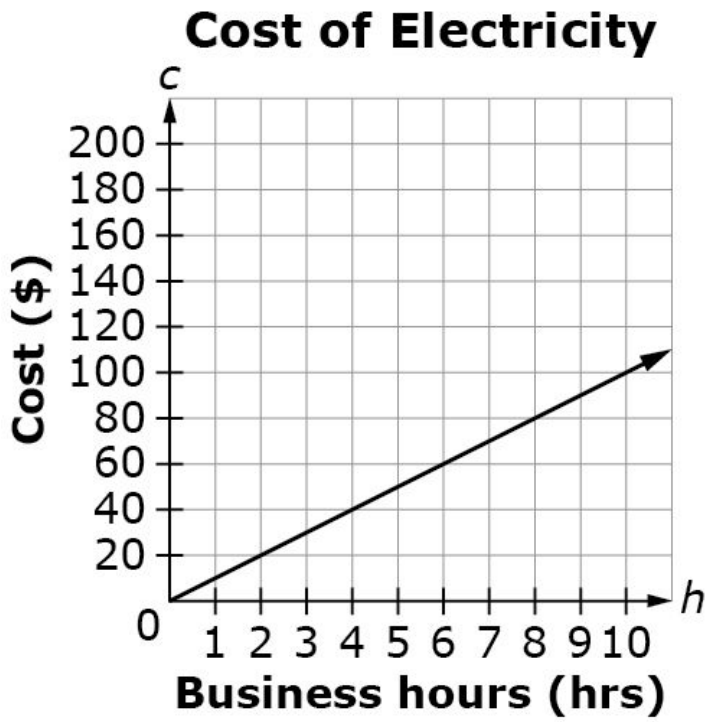
Recognize and represent proportional relationships between quantities. c. Represent proportional relationships by equations. For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.

Evidence Required

The student represents proportional relationships between quantities using equations

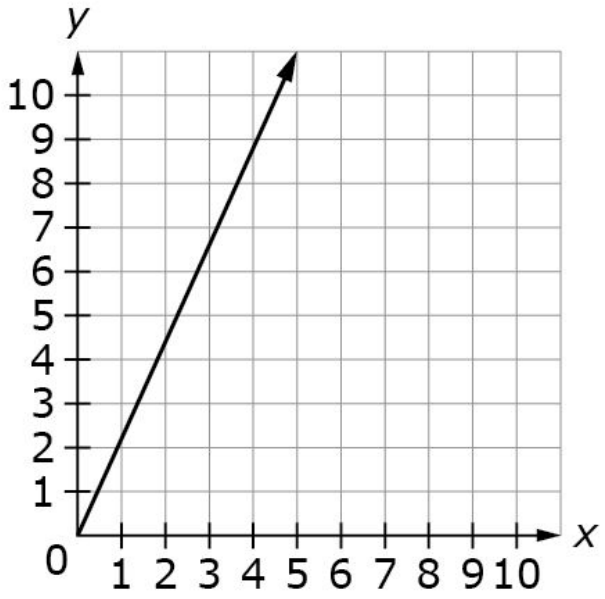
Question Type 1: The student is presented with two quantities in a contextual proportional relationship given in a graph or table.

1. This graph shows the relationship between the number of hours (h) a business operates and the total cost of electricity (c).



Find the constant of proportionality (r) for this relationship. Using the value for k, enter an equation in the form of c = rh that represents the relationship between the number of hours (h) and the total cost (c).

2. This graph shows a proportional relationship between x and y.



Find the constant of proportionality (k). Using the value for k, enter an equation in the form of y = kx.

3. This table shows a proportional relationship between x and y.

x	y
4	48
5	60
8	96

Find the constant of proportionality (k). Using the value for k, enter an equation in the form of y = kx.

Rubric: (1 point) Student enters the correct equation (e.g., c = 10h; y = 2x; y = 12x).

Response Type: Equation/Numeric

Claim 1 7.RP.A.2d DOK Level 2

Recognize and represent proportional relationships between quantities. d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.

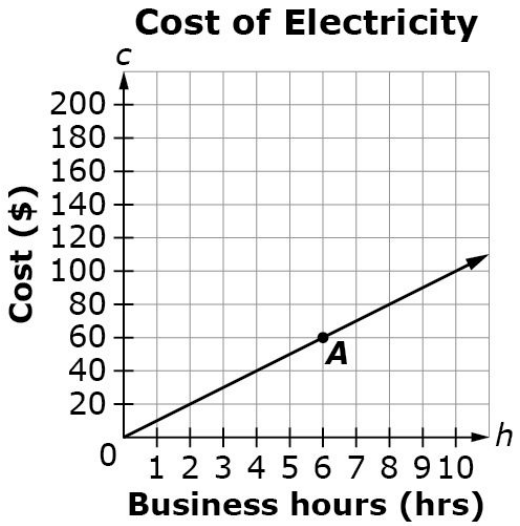
These pages were adapted from open source documents available on the Smarter Balanced Website: http://www.smarterbalanced.org/assessments/development/ August 2016

Evidence Required

The student interprets specific values from a proportional relationship in the context of a problem situation.

Question Type 1: The student is presented with a graph of a proportional relationship where specific values may be emphasized.

1. This graph shows the relationship between the number of hours (h) a business operates and the total cost (c) of electricity.



Select True or False for each statement about the graph.

Statement	True	False
Point A represents the total cost of electricity when operating the business for 6 hours.		
The total cost of electricity is $8 when operating the business for 80 hours.		
The total cost of electricity is $10 when operating the business for 1 hour.		

Rubric: (1 point) Student determines each statement as being either true or false (e.g., T, F, T). Each statement is a sentence describing one of the points in the context. False statements should be statements that use the wrong values or switch the values when interpreting the graph. More difficult statements are about points beyond the visible portion of the graph.

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Response Type: Matching Tables

Claim 2 Problem Solving Question Banks

Claim Descriptors and Targets

Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.

Example 1

Luke buys a television that is on sale for 25% off the original price. The original price is $120 more than the sale price.

What is the original price of the television?

Rubric: (1 point) The student enters the correct original price in the response box (e.g., 480).

Response Type: Equation/Numeric

Example 2

Elly poured $\frac{1}{10}$ gallon of water into an empty bottle. Now it is $\frac{1}{2}$ full. How many cups of water does a full bottle hold? • There are 16 cups in one gallon.

Enter the total number of cups that are in the bottle when it is full. Rubric: (1 point) The student enters the correct number of cups in the response box (e.g., 3 $\frac{1}{5}$ or 3.2). Response Type: Equation/Numeric

Example 3

Justin's car can travel 77.5 miles using 3.1 gallons of gas.

At this rate, how far, in miles, can Justin travel using 8.2 gallons of gas?

Enter the distance in the response box.

Rubric: (1 point) The student enters the correct distances in the response boxes (e.g., 205).

Response Type: Equation/Numeric

Example 4

The school bus driver follows the same route to pick students up in the morning and to drop them off in the afternoon. Because of traffic, the afternoon drive takes 1.5 times as long as the morning drive.

Enter an equation that represents the relationship between the number of minutes x, of the morning drive, to the total number of minutes, y, that the bus driver spends picking up and dropping off students each day.

Rubric: (1 point) The student enters a correct equation in the response box (e.g., y=2.5x).

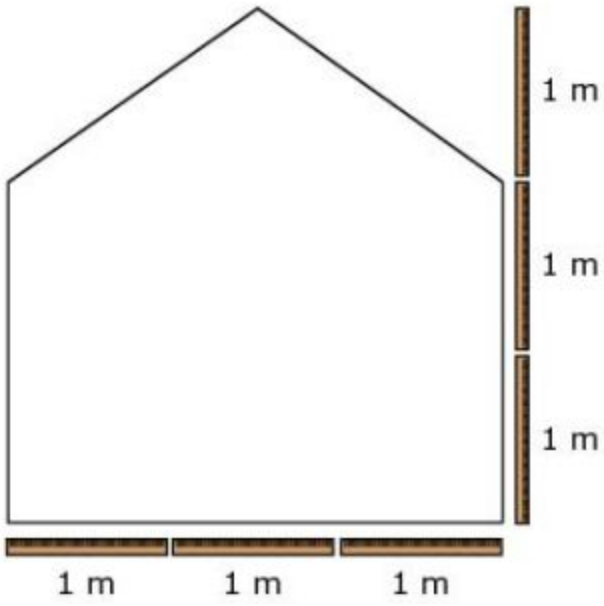
Response Type: Equation/Numeric

Item Commentary: Notice that although the equation is simple, finding the constant of proportionality is not as straightforward as it would appear to be, which prevents extracting the equation through simple keyword analysis. Indeed, keyword analysis might lead to the wrong equation (y=1.5x).

Example 5

John needs to paint one wall in his school. He knows that one can of paint covers an area of 24 square feet. John uses a meter stick to measure the dimensions of the wall, as shown.
• 1 meter is approximately 39 inches

What is the fewest number of cans of paint John can use to paint the wall?



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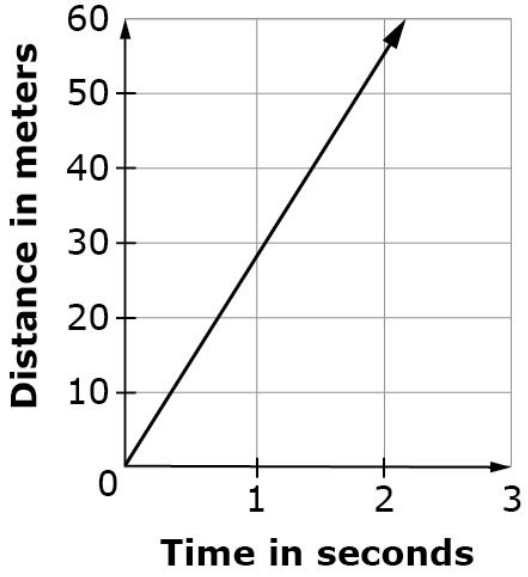
Rubric: (1 point) The student enters the correct number of cans of paint in the response box (e.g., 4).

Response Type: Equation/Numeric

Example 6

A car is traveling on the highway. The distance, in meters, it has traveled over a two-second interval is shown in the graph. A crow can fly up to 32 meters per second. Would it be possible for a crow to pass the car?

A. Yes, it is possible for a crow to pass the car.
B. No, it is not possible for a crow to pass the car.
C. The speed of the car and the maximum speed of the crow are too close to tell.
D. There is not enough information to answer the question.



Rubric: (1 point) The student selects the correct answer choice (e.g., A).

Response Type: Multiple choice, single correct response

Claim 3 Communicating Reasoning Question Banks

Claim Descriptors and Targets

Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.

These pages were adapted from open source documents available on the Smarter Balanced Website: http://www.smarterbalanced.org/assessments/development/ August 2016

Example 1

A robot moves at a constant speed. It travels n miles in t minutes. The robot's pace is the number of minutes it takes to travel one mile.

Part A
A. What is the robot's speed in miles per minute?
B. What is the robot's pace in minutes per mile?

Part B
If the robot's speed is greater than 1, then the pace is

A. Greater than 1.
B. Equal to 1.
C. Less than 1.
D. Cannot be determined.

Explain your reasoning.

Rubric: (2 points) The student enters the correct speed (n/t) in the first response box and the correct pace (t/n) in the second response box and selects the correct statement about the pace (C) and enters a correct explanation (see Examples below).
(1 point) The student gets Part A right or Part B right, but not both.

Example 1
If the speed a/b is greater than 1, then the pace b/a must be less than one. The speed and the pace are reciprocals. If a number is greater than 1, then its reciprocal is less than one and vice-versa.

Example 2
The speed is greater than 1, so a/b>1. If we multiply both sides by b we get a>b. If we divide both sides by a, we get 1>b/a, which is the pace. So the pace is less than 1.

Response Type: Equation/numeric, multiple choice single correct response, hand-scored text box.

Example 2

Green paint can be made by mixing yellow paint with blue paint. Two mixtures make the same shade of green if the ratio of yellow to blue is the same. Assume n is a positive number. Identify one or more of the mixtures below that will make the same shade of paint as a mixture of 10 liters of yellow paint and 15 liters of blue paint. Answer "Yes" if it will make the same shade of paint, answer "No" if it will not.

	Liters of Yellow Paint	Liters of Blue Paint	Yes	No
Mixture 1	$2n$	3		
Mixture 2	2	$3n$		
Mixture 3	$2n$	$3n$		

Rubric: (1 point) The student identifies the correct mixture (NNY).
Response Type: Matching Table

Note: A drag-and-drop version of this could allow students to determine the equivalent mixtures themselves.

Example 3

Dena is trying to solve this problem:

A store has a sale where every item has a sale price that is 20% less than the regular price.

Write an expression that represents the sale price of an item if the regular price is p dollars. Dena said, “To find 20% of a number, I should multiply by 0.20. So the sale price of an item will be 0.20p.”

Which statement best describes Dena’s reasoning?

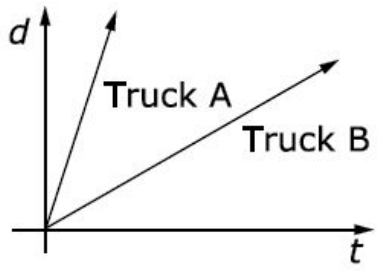
A. Dena is correct.
B. Dena needs to subtract 0.20p from the regular price, p.
C. Dena should calculate the sale price as 20p and then divide by 100.
D. Dena is trying to solve an impossible problem because it doesn’t say what the regular price is.

Rubric: (1 point) The student selects the statement that represents correct reasoning (B).

Response Type: Multiple choice, single correct response

Example 4

Two trucks are traveling on a highway at a constant speed. The graphs of their distances, d, over time, t, are shown.



Which truck is traveling faster, and how do you know?

Truck [drop-down menu choices: A, B] is traveling faster because the graph is [drop-down menu choices: steeper, less steep, longer, shorter].

Rubric: (1 point) The student chooses the correct truck (A) and the correct reason (steeper).

Response Type: Drop-down menu

Claim 4 Modeling and Data Analysis Question Banks

Claim Descriptors and Targets

Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

Example 1

Example Item 4C.2a (Grade 7)
Primary Target 4C (Content Domain RP), Secondary Target 1A (CCSS 7.RP.A), Tertiary Target 4F
[Adapted from Illustrative Mathematics task 1564.]

Chichén Itzá was a Mayan city in what is now Mexico. The picture shows El Castillo, also known as the pyramid of Kukulcán, which is located in the ruins of Chichén Itzá.

The pyramid is approximately 30 meters tall, and there are 91 steps leading up to a temple at the top.

What additional information do you need to know to estimate the height above the ground, in meters, of the 50th step? Select all that apply.

A. Each of the steps has approximately the same height.
B. The base of the pyramid is about 55 meters wide.
C. The height of the temple is about 6 meters.
D. The base of the pyramid is a square.

Rubric: (1 point) The student selects the correct options (A and C).

Response Type: Multiple Choice, multiple correct response