Colorado Measures of Academic Success

Grade 7 Mathematics

Answer Key with Scoring Rubrics

Practice Resource for Students

Table of Contents

ITEM INFORMATION

Colorado Academic Standard (CAS) Evidence Outcome

Describes the evidence that demonstrates that a student is meeting the grade level expectation at a mastery level.

Evidence Statement

Describes the knowledge or skills that an assessment item/task elicits from students. Full descriptions of Evidence Statements and their alignment to the Colorado Academic Standards are located at http://cde.state.co.us/assessment/cmas_testdesign.

Subclaim

The reporting category of the associated CAS.

- Mathematics
  - Subclaim A – Major Content
  - Subclaim B – Supporting Content
  - Subclaim C – Expressing Mathematical Reasoning
  - Subclaim D – Modeling and Application

ITEM TYPES

Items are questions that appear on the assessments. They are presented in three different ways.

Selected Response (Multiple Choice, Multiple Response, and Fill in the Blank):

For multiple choice and multiple response items, students select a correct answer out of provided choices. For fill in the blank items, students type/write their answer in a blank box.

Technology-Enhanced (Bar Graph, Drag and Drop, Inline Choice, Hot Spot, and Match Table Grid):

Students show their answer using technology, such as by creating a bar graph using a template provided by the online testing system or on the paper-based test. Drag and drop items require students to drag answer choices into correct answer bays (draw lines or write corresponding letters for paper-based testing). Inline choice items require students to select their answer from a drop-down menu (circle answer from a list of choices for paper-based testing) to complete a sentence or sentences. Hot spot items require students to select the correct response from its location in an image (write corresponding letters or circle answer for paper-based testing). Match table grid items require students to check checkboxes in cells to indicate a match between the column and row labels.

Constructed Response:

Students construct an open-ended response.

STUDENT PERFORMANCE

P Value – Selected Response Only

The P value represents the percentage of students who answered each selected response question correctly. For example, if the P value associated with a question is 0.64, then 64% of students responded to the question with the correct answer.

Score Point Distribution – Constructed Response Only

The score point distribution provides the percentage of students who scored at each possible score point for constructed response questions.

In addition to score point distribution, the scoring guide, scoring rubric, and sample student responses at each score point are provided for constructed response items.

ANSWER KEY: ITEM SET 1

Item Set 1 - Question 1 (TEI Equation Editor)

In 1 year, the water level of a lake changes by $-\frac{3}{8}$ inch.

If the water level of the lake continues to change at this rate for 7 years, how many inches will the water level of the lake have changed?

Enter your answer in the space provided. Enter **only** your answer.

$$-2\frac{5}{8}$$

Item Information		
Answer:	See Image	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.NS.A.3	Solve real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)
Evidence Statement:	7.NS.3	Solve real-world and mathematical problems involving the four operations with rational numbers. i) Tasks are one-step problems. ii) Tasks sample equally between addition/subtraction and multiplication/division. iii) Tasks involve at least one negative number. iv) Tasks are not limited to integers.
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.324	

Create an expression that has the same value as $(6x - 4) + (x + 5)$.

Drag and drop the numbers into the expression. Each number may be used once, more than once, or not at all.

| 1 | 2 | 4 | 5 | 6 | 7 | 9 | 11 |

$\boxed{7}\ x+\ \boxed{1}$

Item Information		
Answer:	See Image	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.EE.A.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
Evidence Statement:	7.EE.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. i) Tasks are not limited to integer coefficients. ii) Tasks may involve issues of strategy, e.g., by providing a factored expression such as y(3+x+k) and a fully expanded expression 3y + xy + ky, and requiring students to produce or identify a new expression equivalent to both (such as y(3+x) + yk).
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.31	

Which expression is equivalent to $-\frac{3}{5}\left(7 - 3\frac{1}{3}\right)$?

○ A. $\left(-\frac{3}{5}\right)(^-7) + \left(-\frac{3}{5}\right)\left(^-3\frac{1}{3}\right)$

○ B. $-\left(-\frac{3}{5}\right)(7) - \left(-\frac{3}{5}\right)\left(3\frac{1}{3}\right)$

○ C. $-\left(-\frac{3}{5}\right)(7) - \left(-\frac{3}{5}\right)\left(^-3\frac{1}{3}\right)$

◉ D. $\left(-\frac{3}{5}\right)(7) + \left(-\frac{3}{5}\right)\left(^-3\frac{1}{3}\right)$

Item Information		
Answer:	D	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.NS.A.2.a	Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (-1)(-1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
Evidence Statement:	7.NS.2a-1	Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying. i) Tasks do not have a context. ii) Tasks are not computation tasks but rather require students to demonstrate conceptual understanding, for example by providing students with a numerical expression and requiring students to produce or recognize an equivalent expression using properties of operations, particularly the distributive property. For example, given the expression (-3)(6 + -4 + -3), the student might be asked to recognize that the given expression is equivalent to (-3)(6 + -4) + (-3)(-3).
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.377	

Which expression is equivalent to $-\frac{1}{5}(y-3)+5+\frac{3}{10}y$?

Select **all** expressions that are equivalent.

- ☑ A. $-\frac{1}{5}y+5\frac{3}{5}+\frac{3}{10}y$

- ☐ B. $-\frac{1}{5}y+4\frac{2}{5}+\frac{3}{10}y$

- ☑ C. $\frac{1}{10}y+5\frac{3}{5}$

- ☐ D. $\frac{1}{2}y+4\frac{2}{5}$

- ☐ E. $\frac{1}{10}y+2$

Item Information		
Answer:	A, C	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.EE.A.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
Evidence Statement:	7.EE.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. i) Tasks are not limited to integer coefficients. ii) Tasks may involve issues of strategy, e.g., by providing a factored expression such as y(3+x+k) and a fully expanded expression 3y + xy + ky, and requiring students to produce or identify a new expression equivalent to both (such as y(3+x) + yk).
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.271	

The graph represents the amount of water, in gallons, y, that flows through a garden hose in x minutes.

Garden Hose
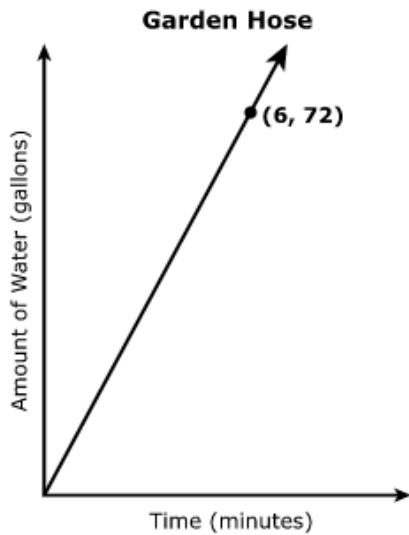
Which statement correctly describes the meaning of the point shown on this graph?

- ● A. Every 6 minutes, 72 gallons of water flow through the hose.

- ○ B. Every 72 minutes, 6 gallons of water flow through the hose.

- ○ C. Every 6 minutes, 12 gallons of water flow through the hose.

- ○ D. Every 12 minutes, 6 gallons of water flow through the hose.

Item Information		
Answer:	A	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.RP.A.2.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.
Evidence Statement:	7.RP.2d	Recognize and represent proportional relationships between quantities. d.Explain what a point (x, y) on the graph of a proportional relationships means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate. i) Tasks require students to interpret a point (x, y) on the graph of a proportional relationship in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate. For the explanation aspect of standard 7.RP.2d, see 7.C.6.1. ii) Tasks will include proportional relationships that only involve positive numbers.
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.638	

A person paid a total of $38.50, before tax, for flowers and dirt at a store. The price of the flowers was $4.50 per container. The price of the dirt was $7.00 per bag.

If the customer bought one bag of dirt, how many containers of flowers did the customer buy?

○ A. 5

◉ B. 7

○ C. 9

○ D. 10

Item Information		
Answer:	B	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.EE.B.4.a	Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?
Evidence Statement:	7.EE.4a-1	Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities. a. Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. i) Comparison of an algebraic solution to an arithmetic solution is not assessed here; for this aspect of standard 7.EE.4a, see 7.C.5.
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.663	

A student spent $18 for a haircut this week.

Which event, when combined with the student spending $18, will result in the student having $0 remaining?

- ● A. The student earned $18 for cleaning out his neighbor's garage.

- ○ B. The student paid his little brother $18 for doing his chores.

- ○ C. The student purchased a gift for his mom for $18.
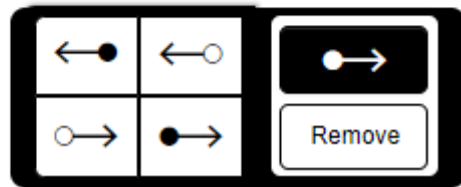
- ○ D. The student gave $18 to a friend.

Item Information		
Answer:	A	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.NS.A.1.a	Describe situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.
Evidence Statement:	7.NS.1a	Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged. i) Tasks require students to recognize or identify situations of the kind described in standard 7.NS.1a.
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.62	

A student wants to walk 30 or more total miles this month and has already walked 18 of the 30 total miles. The student walks at a constant speed of 3 miles per hour.

Graph *n*, all the possible values for the number of additional hours it will take the student to walk at least 30 total miles this month.
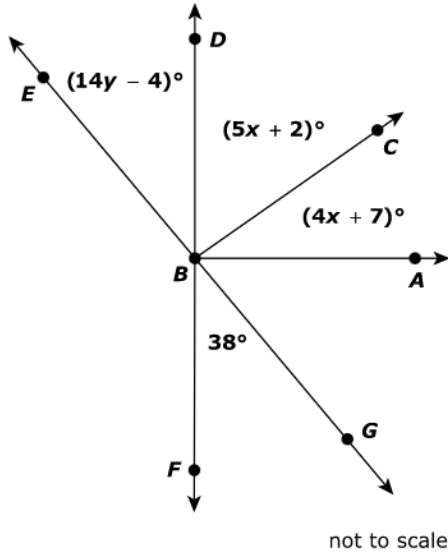
Select a ray. Drag the point on the ray to the appropriate location on the number line.

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

←⬤ ←○ ○→ ⬤→ Remove

Item Information		
Answer:	See Image	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.EE.B.4.b	Solve word problems leading to inequalities of the form px + q > r or px + q< r, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solutions.
Evidence Statement:	7.EE.4b	Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities. b. Solve word problems leading to inequalities of the form px + q > r or px + q < r, where p, q and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make and describe the solutions. i) Tasks may involve <, >, ≤ or ≥.
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.

The diagram shows angles formed by the intersections of lines and rays.

not to scale

Part A

Angles *DBC* and *CBA* are complementary.

What is the measure of angle *DBC*?

○ A. $19°$

○ B. $43°$

○ C. $45°$

● D. $47°$

Part B

Line *EG* and line *DF* intersect at point *B* to form vertical angles *EBD* and *FBG*.

What is the value of *y*?

Enter your answer in the box.

`3`

Item Information		
Answer:	Part A = D Part B = See Image	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.G.B.5	Use facts about supplementary, complementary, vertical, and adjacent angles in a multistep problem to write and solve simple equations for an unknown angle in a figure.
Evidence Statement:	7.G.5	Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. i) Pool should contain tasks with and without context. ii) Tasks involving writing or solving an equation should not go beyond the equation types described in 7.EE.4a. (px +q = r and p(x + q) = r where p, q, and r are specific rational numbers.
Subclaim:	B - Supporting Content	The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.202	

ANSWER KEY: ITEM SET 2, CALCULATOR SECTION

Item Set 2 - Question 1 (Fill in the Blank, Selected Response)

The table shows money conversion rates for the United States dollar (USD), the Caymanian dollar (KYD), the Australian dollar (AUD), the Indian rupee (INR), and the Argentine peso (ARS). Each conversion rate is rounded to the nearest hundredth.

Money Conversion Rate
1 USD = 0.82 KYD
1 USD = 1.32 AUD
1 USD = 64.57 INR
1 USD = 16.22 ARS

Part A

Approximately how many AUD are equal to 35 USD?

Enter your answer in the box.

46.2

Part B

Approximately how many USD are equal to 50 ARS?

- ● A. 3.08
- ○ B. 37.88
- ○ C. 66.00
- ○ D. 811.00

Part C

How many INR are equal to 150 AUD? Round to the nearest whole number.

- ○ A. 2
- ○ B. 114
- ○ C. 1,843
- ● D. 7,338

Part D

How many KYD are equal to 810 ARS? Round your answer to the nearest whole number.

- ● A. 41
- ○ B. 50
- ○ C. 61
- ○ D. 664

Item Information		
Answer:	Part A = See Image Part B = A Part C = D Part D = A	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.RP.A.3	Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.
Evidence Statement:	7.RP.3-1	Use proportional relationships to solve multistep ratio problems. i) Tasks will include proportional relationships that only involve positive numbers.
Subclaim:	A – Major Content	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.401	

Students from two schools attend a game tournament. Data about the age of the students from each school are shown in the line plot.

Age of Students

School S

School R

```
    7   8   9  10  11  12  13  14  15  16
```
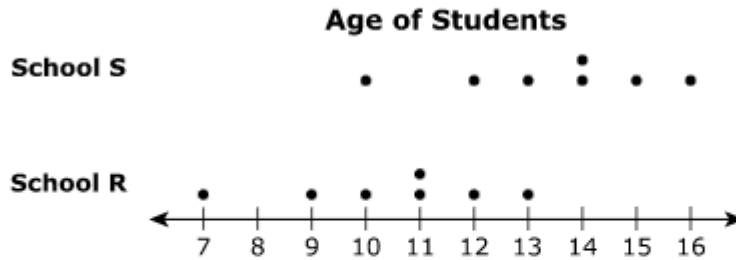
The mean age, in years, of the students from School R is 10.4. The mean age, in years, of the students from School S is 13.4. The mean absolute deviation for each group of students is about 1.5.

Select from the drop-down menus to correctly complete the sentence.

The difference between the mean ages is [3 ▾] , which is about [2 ▾] times the mean absolute deviation for either school.

Item Information		
Answer:	See Image	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.SP.B.3	Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.
Evidence Statement:	7.SP.3	Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. For example, the mean height of players on the basketball team is 10cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable. i) Tasks may use mean absolute deviation, range, or interquartile range as a measure of variability. ii) Tasks may include pairing concepts of mean absolute deviation and mean or median and interquartile range.
Subclaim:	B - Supporting Content	The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.383	

Item Set 2 - Question 3 (Constructed Response)

The number of players participating in an online game increases each day. On the day of the game's release, there are no players. One day after the release of the game, there are 1,208 players. Two days after the release, there are 2,398 players. Three days after the release, the game has 3,621 players.

- Create an equation to approximate the number of players, p, that will participate in the game d days after the game's release. Explain how you created this equation.
- Using your equation, estimate how many players there will be 7 days after the game's release.

Enter your equation, your explanation, and your answer in the space provided.

Item Information		
Answer:	See Scoring Rubric and Sample Student Response	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.RP.A.2.c	Identify and represent proportional relationships between quantities. (CCSS: 7.RP.A.2) 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=np. (CCSS: 7.RP.A.2.c)
Evidence Statement:	7.D.3	Micro-models: Autonomously apply a technique from pure mathematics to a real-world situation in which the technique yields valuable results even though it is obviously not applicable in a strict mathematical sense (e.g., profitably applying proportional relationships to a phenomenon that is obviously nonlinear or statistical in nature).
Subclaim:	D – Modeling and 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).
P Value:	0.18	

Scoring Rubric	
Points	**Attributes**
3	Student response includes each of the following 3 elements. • **Modeling component**: Valid equation to approximate the number of players, p, that will participate in the game, d, after the game's release. • **Modeling component:** Valid explanation of how the equation was created. • **Computation component**: Valid estimate, based on the equation, of how many players there will be 7 days after the game's release. **Note**: A range of answers is possible depending on estimated constant of proportionality.
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.

Sample Student Response:	**Sample Solution 1:** My equation is: $p = 1,200d$ I created this equation by looking at the number of game players each day, and each day there were approximately 1,200 more players. I used my equation to estimate how many players there will be after 7 days. $p = 1,200 \times 7$ $p = 8,400$. This is the approximate number of players on day 7.

Annotation for Sample Student Response:	**Solution 1, Score Point 3**
	The response receives full credit. It includes each of the 3 required elements.
	Modeling Component:
	• **Student Response:** My equation is: $p = 1,200d$
	   ◦ **Rationale for Score:** A valid equation is provided that approximates the number of players, p, that will participate in the game after, d, days ($p = 1,200d$).
	Modeling Component:
	• **Student Response:** I created this equation by looking at the number of game players each day, and each day there were approximately 1,200 more players.
	   ◦ **Rationale for score:** A valid explanation of how the equation was created is provided (looking at the number of game players each day, and each day there were approximately 1,200 more players). The student looked at the added number of players each day and took an average of that number to use as the constant of proportionality in the equation.
	Computation Component:
	• **Student Response:** I used my equation to estimate how many players there will be after 7 days. $p = 1,200 \times 7$, $p = 8,400$. This is the approximate number of players on day 7.
	   ◦ **Rationale for score:** A valid estimate of how many players there will be after 7 days is provided. The student uses their equation to determine an estimated number of players 7 days after the game is released ($p = 1,200 \times 7$, $p = 8,400$).
	
	Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.

Part A

Consider the expression $\frac{1}{2}x + 3 + \frac{1}{3}x - 4$.

Write an equivalent expression with exactly two terms.

Enter your expression in the space provided. Enter **only** your expression.

$$\frac{5}{6}x - 1$$

Part B

A student states that the expressions $\frac{1}{2}(x + 3) + \frac{1}{3}(x - 4)$ and $\frac{1}{2}x + 3 + \frac{1}{3}x - 4$ are equivalent.

- Explain why the student's reasoning is incorrect.
- Create an expression, with two terms, that is equivalent to $\frac{1}{2}(x + 3) + \frac{1}{3}(x - 4)$. Show your work or explain your reasoning.

Enter your explanations or work and your answer in the space provided.

Item Information		
Answer:	See Scoring Rubric and Sample Student Responses	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.EE.A.1	Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
Evidence Statement:	7.C.1-2	Base explanations/reasoning on the properties of operations. Content Scope: Knowledge and skills articulated in 7.EE.1 i) Tasks should not require students to identify or name properties.
Subclaim:	C - Expressing Mathematical Reasoning	The student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others, and/or attending to precision when making mathematical statements.
P Value:	0.15	

Scoring Rubric – Part A	
Points	**Attributes**
1	**Computation Component:** • Student response: $\frac{5}{6}x - 1$ or an equivalent expression with exactly two terms. Variable substitution is not allowed. $\frac{1}{2}x + 3 + \frac{1}{3}x - 4$ $\frac{3}{6}x + 3 + \frac{2}{6}x - 4$

	$\frac{5}{6}x - 1$
0	Student response is incorrect or irrelevant.

Scoring Rubric – Part B	
Points	**Attributes**
3	Student response includes each of the following 3 elements. • **Reasoning component**: Valid explanation for why the student's reasoning is incorrect • **Computation component**: Correct expression, with two terms, that is equivalent to $\frac{1}{2} + (x + 3) + \frac{1}{3}(x - 4)$ • **Reasoning component**: Valid explanation or work for how the equivalent expression was determined
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	**Sample Solution 1:** The student's reasoning is incorrect because instead of distributing both the $\frac{1}{2}$ and $\frac{1}{3}$ to both terms that make up the expression in the parenthesis they just distributed and multiplied the x's by $\frac{1}{2}$ and $\frac{1}{3}$ and not the 3 and -4. A correct equivalent expression is $\frac{5}{6}x + \frac{1}{6}$. You can find this expression by distributing and multiplying the variable that is outside the parenthesis to both terms inside the parenthesis and get these terms: $1\frac{1}{2} + \frac{1}{2}x + \frac{1}{3}x - 1\frac{1}{3}$. You can then make a common denominator out of all the fractions with 6, then combine and simplify like terms and get the equivalent expression $\frac{5}{6}x + \frac{1}{6}$.

Annotation for Sample Student Response:	**Solution 1, Score Point 3**
	The response receives full credit. It includes each of the 3 required elements.
	Reasoning Component:
	• **Student Response:** The student's reasoning is incorrect because instead of distributing both the $\frac{1}{2}$ and $\frac{1}{3}$ to both terms that make up the expression in the parenthesis they just distributed and multiplied the x's by $\frac{1}{2}$ and $\frac{1}{3}$ and not the 3 and -4.
	   ○ **Rationale for Score:** A valid explanation is provided for why the student's reasoning is incorrect. The student explains that the fraction outside the parenthesis was only distributed to the first variable, x, and not to the other number inside the parenthesis (instead of distributing both the $\frac{1}{2}$ and $\frac{1}{3}$ to both terms that make up the expression in the parenthesis they just distributed and multiplied the x's by $\frac{1}{2}$ and $\frac{1}{3}$ and not the 3 and -4).
	Computation Component:
	• **Student Response:** A correct equivalent expression is $\frac{5}{6}x + \frac{1}{6}$
	   ○ **Rationale for score:** A correct equivalent expression with two terms is provided ($\frac{5}{6}x + \frac{1}{6}$).
	Reasoning Component:
	• **Student Response**: You can find this expression by distributing and multiplying the variable that is outside the parenthesis to both terms inside the parenthesis and get

these terms: $1\frac{1}{2} + \frac{1}{2}x + \frac{1}{3}x - 1\frac{1}{3}$. You can then make a common denominator out of all the fractions with 6, then combine and simplify like terms and get the equivalent expression $\frac{5}{6}x + \frac{1}{6}$.

- o **Rationale for score**: A valid explanation is provided for how the equivalent expression was determined. The student explains that the fraction outside the parenthesis must be correctly distributed and multiplied to both terms inside the parenthesis, then the expression can be simplified to two terms (You can find this expression by distributing and multiplying the variable that is outside the parenthesis to both terms inside the parenthesis and get these terms: $1\frac{1}{2} + \frac{1}{2}x + \frac{1}{3}x - 1\frac{1}{3}$. You can then make a common denominator out of all the fractions with 6, then combine and simplify like terms and get the equivalent expression $\frac{5}{6}x + \frac{1}{6}$).
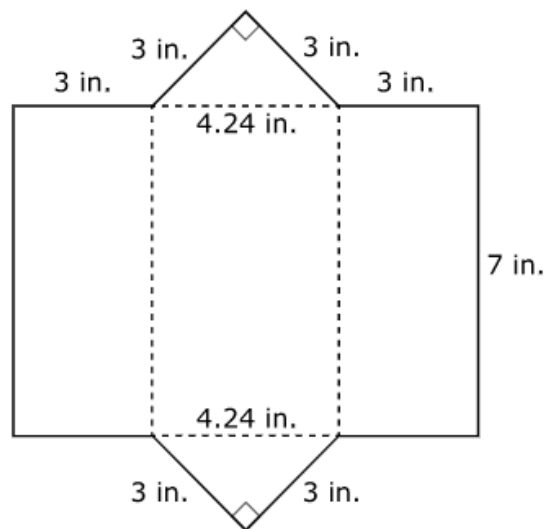
Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.

Part A

A person wants to make a pencil case in the shape of a triangular prism. He traces the outline using the pattern shown.

- Show or explain the steps needed to calculate the amount of material, in square inches, needed to make 1 pencil case.
- What is the amount of material, in square inches, needed to make 1 pencil case?
- Create an expression that can be used to determine the amount of material, in square inches, to make *n* pencil cases.

Enter your explanations, your work, and your answer in the space provided.

Part B

The material for the pencil case is sold in square-shaped pieces that are 1 foot long. Each piece costs $5.

- Find the area, **in square inches**, of one piece of material.
- What is the cost per square inch of the material? Show or explain your work.

Enter your answer and your work or explanation in the space provided.

Item Information		
Answer:	See Scoring Rubric and Sample Response	
Colorado Academic Standards (CAS) Evidence Outcomes:	6.G.A.4	Represent three-dimensional figures using nets made up of rectangles and triangles and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
	6.G.A.1	Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
	6.RP.A.3b	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?
Evidence Statement:	7.D.2	Solve multi-step contextual problems with degree of difficulty appropriate to grade 7, requiring application of knowledge and skills articulated in 6.RP.A, 6.EE.C, 6.G. i) Tasks may have scaffolding if necessary, in order to yield a degree of difficulty appropriate to grade 7.
Subclaim:	D – Modeling and 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).
P Value:	0.162	

Scoring Rubric – Part A	
Points	**Attributes**
3	Student response includes each of the following 3 elements. • **Modeling component**: Valid work or explanation to determine the amount of material needed for 1 pencil case • **Computation component**: Correct amount of material, in square inches, needed to make 1 pencil case, 80.68 • **Modeling component**: Valid expression that can be used to determine the amount of material, in square inches, to make n pencil cases, 80.68n
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	**Sample Solution 1:** To find the sides, 7 x 3 x 2 = 42, so both sides have a total surface area of 42. Next, to find the triangles (top and bottom), $\frac{3\times3}{2} \times 2$, so 9 in total. Finally, to find the middle, 4.24 x 7 = 29.68. So, in total 42 + 9 + 29.68 = 80.68 sq. in. The amount of material needed to make one pencil case is 80.68 square inches. To find an equation that determines the amount of material in square inches to make n pencil cases you use the equation 80.68 × n.
Annotation for Sample Student Response:	**Solution 1, Score Point 3** The response receives full credit. It includes each of the 3 required elements. **Modeling Component:** • **Student Response:** To find the sides, 7 x 3 x 2 = 42, so both sides have a total surface area of 42. Next, to find the triangles (top and bottom), $\frac{3\times3}{2} \times 2$, so 9 in total. Finally, to find the middle, 4.24 x 7 = 29.68. So, in total 42 + 9 + 29.68 = 80.68 ○ **Rationale for Score:** Valid work provided to determine the amount of material

need to make 1 pencil case. The student accounts for each of the three rectangle areas and the two triangle areas; then adds the areas and finds a total amount of material needed (To find the sides, 7 x 3 x 2 = 42 . . . find the triangles (top and bottom), $\frac{3 \times 3}{2} \times 2$, so 9 in total . . . to find the middle, 4.24 x 7 = 29.68 . . . 42 + 9 + 29.68 = 80.68 sq. in.).

Computation Component:
- **Student Response:** The amount of material needed to make one pencil case is 80.68 square inches.
  - **Rationale for score:** A correct amount of material needed to make 1 pencil case is provided (80.68 square inches).

Modeling Component:
- **Student Response**: To find an equation that determines the amount of material in square inches to make n pencil cases you use the equation 80.68 × n.
  - **Rationale for score**: A valid expression is provided that can be used to determine the amount of material need to make n pencil cases (80.68 × n).

Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.

Scoring Rubric – Part B	
Points	**Attributes**
3	Student response includes each of the following 3 elements. • **Computation component**: Correct area, in square inches, for one piece of material, 144 • **Computation component**: Correct cost, per square inch, of the material, $0.03 • **Modeling component**: Valid work or explanation to find the cost per square inch of the material
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	**Sample Solution 1:** 1 foot is 12 inches so that means that these squares of material are 12 inches by 12 inches. Using the equation 12 x 12 you get the area of the square which is 144 square inches. To find the cost per square inch, you know that 144 square inches costs $5.00, so the equation 5 ÷ 144 = 0.03472 finds the cost per square inch which you would round to 0.03. It costs $0.03 for 1 square inch of material.

Annotation for Sample Student Response:	**Solution 1, Score Point 3**
	The response receives full credit. It includes each of the 3 required elements.
	Computation Component:
	• **Student Response:** 1 foot is 12 inches so that means that these squares of material are 12 inches by 12 inches. Using the equation 12 x 12 you get the area of the square which is 144 square inches.
	   o **Rationale for Score:** A correct area, in square inches, for one piece of material is provided (144 square inches).
	Computation Component:
	• **Student Response:** It costs $0.03 for 1 square inch of material.
	   o **Rationale for score:** A correct cost per square inch of material is provided ($0.03).
	Modeling Component:
	• **Student Response**: To find the cost per square inch, you know that 144 square inches costs $5.00, so the equation 5 ÷ 144 = 0.03472 finds the cost per square inch which you would round to 0.03.
	   o **Rationale for score**: Valid work is provided to find the cost per square inch of the material. The student divides the cost of one piece of material by the total square inches in one piece, to find the cost per square inch (144 square inches costs $5.00, so the equation 5 ÷ 144 = 0.03472 finds the cost per square inch which you would round to 0.03). Note that rounding to the hundredth position shows understanding that this is a monetary value.
	
	Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.

The table shows a proportional relationship between x and y.

x	y
1.5	0.5
4.5	1.5

Part A

Plot the relationship between x and y.

To graph a line, select two points on the coordinate plane. A line will be drawn through the points.
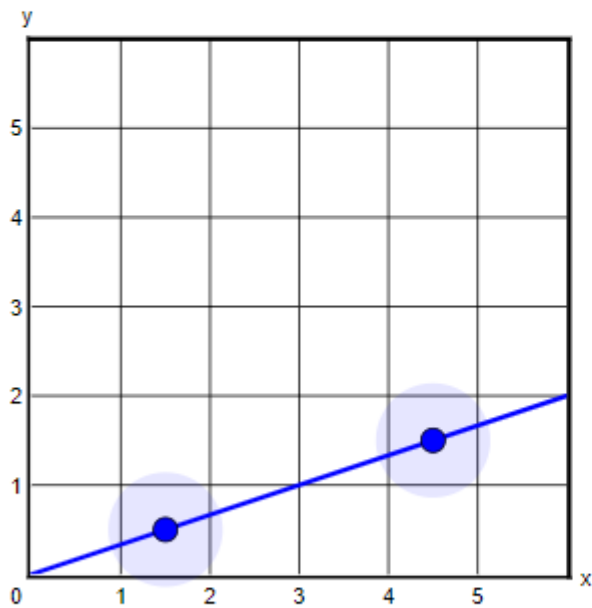
Part B

- Use the graph to explain how the relationship between x and y is proportional.
- Explain or show mathematically how $(11.25, 3.75)$ is a point on the graph, using the constant of proportionality.

Enter your explanations and your work in the space provided.

Item Information	
Answer:	See Scoring Rubric and Sample Student Responses
Colorado Academic Standards (CAS) Evidence Outcomes:	7.RP.A.2.a — Determine 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.
	7.RP.A.2.b — Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
Evidence Statement:	7.C.4 — Base explanations/reasoning on a coordinate plane diagram (whether provided in the prompt or constructed by the student in her response). Content Scope: Knowledge and skills articulated in 7.RP.A. i) Tasks will include proportional relationships that only involve positive numbers.

Subclaim:	C - Expressing Mathematical Reasoning	The student expresses grade/course-level appropriate mathematical reasoning by constructing viable arguments, critiquing the reasoning of others, and/or attending to precision when making mathematical statements.
Score Point Distribution:	2.0% of students earned 3 points. 15.0% of students earned 2 points. 41.4% of students earned 1 point. 41.7% of students earned 0 points.	

Scoring Rubric – Part A (Machine Scored)	
Points	**Attributes**
1	**Computation Component:** Student plots the points (1.5,0.5) and (4.5,1.5) or any two points which pass through the line $y = \frac{1}{3}x$ on the coordinate plane.
0	Student response is incorrect or irrelevant.

Scoring Rubric – Part B	
Points	**Attributes**
2	Student response includes each of the following 2 elements. • **Reasoning component**: Valid explanation for determining if a relationship is proportional by using the graph of the relationship. • **Reasoning component**: Valid explanation by using the constant of proportionality to explain or show how (11.25,3.75) is a point on the graph.
1	Student response includes 1 of the 2 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	This graph shows this is proportional because for every $1\frac{1}{2}$ units on the x axis you go, the line always goes up $\frac{1}{2}$ units on the y axis. This graph also proves this is proportional because the line goes through the point 0,0. I know that the constant of proportionality is $\frac{1}{3}$ because $.5 \div 1.5 = \frac{1}{3}$ and to check this you can do $4.5 \times \frac{1}{3}$ and it does equal 1.5. Then, using the constant you can make the equation $y = \frac{1}{3}x$ and then plug the point 11.25, 3.75 in and if the equation is still correct then that proves these are points on the graph. When you do that you find that 3.75 does equal $\frac{1}{3} \times 11.24$ which proves this is a point on the graph.

Annotation for Sample Student Response:	**Score Point 2**
	The response receives full credit. It includes each of the 2 required elements.
	Reasoning Component:
	
	• **Student Response:** This graph shows this is proportional because for every $1\frac{1}{2}$ units on the x axis you go, the line always goes up $\frac{1}{2}$ units on the y axis. This graph also proves this is proportional because the line goes through the point 0,0.
	
	    ○ **Rationale for Score:** The student provides a valid explanation for determined if the relationship is proportional because the graph is linear (for every $1\frac{1}{2}$ units on the x axis you go, the line always goes up $\frac{1}{2}$ units on the y axis) and passes through the origin (the line goes through the point 0,0).
	
	Reasoning Component:
	
	• **Student Response:** I know that the constant of proportionality is $\frac{1}{3}$ because $.5 \div 1.5 = \frac{1}{3}$ and to check this you can do $4.5 \times \frac{1}{3}$ and it does equal 1.5. Then, using the constant you can make the equation $y = \frac{1}{3}x$ and then plug the point 11.25,3.75 in and if the equation is still correct then that proves these are points on that graph. When you do that you find that 3.75 does equal $\frac{1}{3}$ x 11.24 which proves this is a point on the graph.
	
	    ○ **Rationale for score:** The student provides a valid explanation that uses the constant of proportionality to show that (11.25,3.75) is a point on the graph (constant of proportionality is $\frac{1}{3}$ because $.5 \div 1.5 = \frac{1}{3}$ and to check this you can do $4.5 \times \frac{1}{3}$ and it does equal 1.5. Then, using the constant you can make the equation $y = \frac{1}{3}x$ and then plug the point 11.25,3.75 in . . . 3.75 does equal $\frac{1}{3}$ x 11.24 which proves this is a point on the graph).
	
	Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.

Part A

Based on the sample, approximately how many students in the entire school population prefer spaghetti as their favorite school food?

○ A. 12

○ B. 63

◉ C. 84

○ D. 105

Part B

Based on the sample, which inference can be made?

◉ A. The number of students who like spaghetti is approximately the same as the number who like hamburgers.

○ B. A small number of students bring their own lunch to school.

○ C. Most students eat salad or pizza every day.

○ D. Almost the whole school prefers pizza.

Item Information		
Answer:	Part A = C, Part B = A	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.SP.A.2	Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.
Evidence Statement:	7.SP.2	Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.
Subclaim:	B - Supporting Content	The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.326	

A person can play $\frac{1}{6}$ of a song in $\frac{1}{3}$ of a minute.

How many minutes does it take the person to play the whole song once at this rate?

   ○ A. **3**

   ● B. **2**

   ○ C. $\frac{2}{3}$

   ○ D. $\frac{1}{2}$

Item Information		
Answer:	B	
Colorado Academic Standards (CAS) Evidence Outcomes:	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.
Evidence Statement:	7.RP.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. i) Tasks have a real-world context. ii) An example of like units would be cups of butter to cups of sugar; an example of different units would be miles to hours. Unit conversion is not assessed here.
Subclaim:	A - MajorContent	The student solves problems involving the Major Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.62	

A teacher has an equal number of pink, blue, green, yellow, and purple erasers in a box. She will randomly distribute 1 eraser from the box to each student.

What is the probability that the first eraser that will be distributed is a color other than yellow?

○ A. $\frac{1}{5}$

○ B. $\frac{1}{4}$

○ C. $\frac{3}{4}$

◉ D. $\frac{4}{5}$

Item Information

Answer:	D	
Colorado Academic Standards (CAS) Evidence Outcomes:	7.SP.C.7.a	Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will beselected.
Evidence Statement:	7.SP.7a	Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected. i) Simple events only.
Subclaim:	B - Supporting Content	The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.407	

Item Set 2 - Question 10 (TEI Equation Editor, Selected Response)

A circle is inscribed on a square piece of paper. The radius of the circle is 5 centimeters.
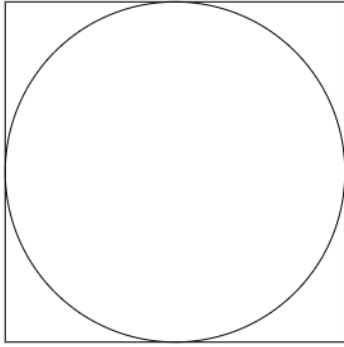
Part A

What is the circumference, in centimeters, of the circle?

Enter your answer in the space provided. Enter **only** your answer.

> 31.40 centimeters

Part B

The circle is cut out and removed from the square. How much paper, in square centimeters, remains after the circle is removed?

- ○ A. $25\pi - 10$
- ○ B. $10\pi - 25$
- ○ C. $100 - (10\pi)$
- ● D. $100 - (25\pi)$

Item Information	
Answer:	Part A = See Rubric, Part B = D
Colorado Academic Standards (CAS) Evidence Outcomes:	7.G.B.4 Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.
Evidence Statement:	7.G.4-1 Know the formulas for the area and circumference of a circle and use them to solve problems. i) Pool should contain tasks with and without context. ii) Tasks may require answers to be written in terms of π.
Subclaim:	B - Supporting Content The student solves problems involving the Additional and Supporting Content for her grade/course with connections to the Standards for Mathematical Practice.
P Value:	0.242

Scoring Rubric – Part A	
Points	**Attributes**
1	Student response is a fraction or decimal value within the range of possible values: 31.40 to 31.43 inclusive or exactly 10π.
0	Student response is incorrect or irrelevant.

A person is planning an event and wants to order chicken and beans from a store.

- The store charges $9.49 per pound of chicken and $5.75 for one quart of beans.
- The person has $70 to purchase the chicken and the beans.

Let p represent the number of pounds of chicken.

- Create an equation that can determine the maximum amount of chicken, in pounds, that can be purchased, along with one quart of beans, using the $70. Do not include tax.
- Solve the equation to determine the maximum amount of chicken that can be purchased. Round your final answer to the nearest quarter pound. Show your work.

Enter your equation, your solution, and your work in the space provided.

Item Information	
Answer:	See Scoring Rubric and Sample Student Responses
Colorado Academic Standards (CAS) Evidence Outcomes:	**7.EE.B.4.a** Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?
	7.EE.B.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.
Evidence Statement:	**7.D.1** Solve multi-step contextual word problems with degree of difficulty appropriate to grade 7, requiring application of knowledge and skills articulated in Type I, Sub-Claim A Evidence Statements. i) Tasks may have scaffolding if necessary, in order to yield a degree of difficulty appropriate to grade 7. ii) Tasks involving writing or solving an equation should not go beyond the equation types described in 7.EE.4a. (px +q = r and p(x + q) = r where p, q, and r are specific rational numbers.)
Subclaim:	**D - Modeling and 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).

Score Point Distribution:	5.0% of students earned 3 points. 11.7% of students earned 2 points. 15.0% of students earned 1 point. 68.3% of students earned 0 points.

Scoring Rubric	
Points	**Attributes**
3	Student response includes each of the following 3 elements. • **Modeling component**: Valid equation equivalent to $9.49p + 5.75 = 70$. • **Computation component:** Correct pounds of chicken that can be purchased, rounded to the nearest quarter pound, 6.75. • **Modeling component**: Valid work to solve the given equation and determine the maximum amount of chicken, in pounds, that can be purchased.
2	Student response includes 2 of the 3 elements.
1	Student response includes 1 of the 3 elements.
0	Student response is incorrect or irrelevant.
Sample Student Response:	**Equation:** $9.49p + 5.75 = 70$ **Maximum amount of chicken:** 6 and $\frac{3}{4}$ **pounds** **Your Work:** $70 - 5.75 = 64.25$ $\qquad 64.25 \div 9.49 = p$ $\qquad p = 6$ and $\frac{3}{4}$

Annotation for Sample Student Response:	**Score Point 3**
	The response receives full credit. It includes each of the 3 required elements.
	Modeling Component:
	• **Student Response: Equation:** $9.49p + 5.75 = 70$.
	    ○ **Rationale for Score:** The student provides a valid equation that determines the maximum amount of chicken, in pounds, that can be purchased, along with one quart of beans, using 70 dollars ($9.49p + 5.75 = 70$). The variable, p, is used to represent the number of pounds that can be purchased. Note that variable substitution is allowed.
	Computation Component:
	• **Student Response: Maximum amount of chicken:** 6 and $\frac{3}{4}$ **pounds**
	    ○ **Rationale for score:** The correct pounds of chicken, rounded to the nearest quarter pound, is provided (6 and $\frac{3}{4}$).
	Modeling Component:
	• **Student Response: Your Work:** $70 - 5.75 = 64.25$, $64.25 \div 9.49 = p$, $p = 6$ and $\frac{3}{4}$
	    ○ **Rationale for score:** The student provides valid work for how to solve the equation to determine the maximum pounds of chicken that can be purchased ($70 - 5.75 = 64.25$, $64.25 \div 9.49 = p$, $p = 6$ and $\frac{3}{4}$).
	
	Note: The equation must have one variable and at least one operation.
	Note: Equation should not include tax.
	Note: Variable substitution is allowed.
	Note: Sample student responses are not representative of all correct answers for an item and are only provided as a guide to assist teachers with scoring.