NWEA MATH EXEMPLARS

Grade 7

Contents

Purpose

Have you ever thought about what it means for an assessment item to be aligned to a College- and Career-Readiness (CCR) mathematics standard? We have, as alignment is necessary to ensure that assessments accurately measure targeted instructional standards. True alignment requires much more than a simple match to mathematical topics. A high-quality, aligned item attends to the verbs in the standard while requiring students to demonstrate all or part of the knowledge and/or skill expressed in the standard. At the same time, an aligned assessment item will match the aspects of rigor addressed in the standard language. That is, it will attend to Conceptual Understanding, Procedural Skill and Fluency, or Application—or some combination of these. For example, a procedural standard should be assessed by a procedural item, while a conceptual standard should be assessed by a conceptual item. A high-quality, aligned item is designed to maximize the likelihood that students provide a correct response by demonstrating the knowledge or skill required in the content of the standard. High-quality items do not promote the use of mnemonics or tricks, but instead fit within the larger coherent vision of the standards. Aligned items focus on the mathematics in a specific standard, match the rigor of the standard, and complement the overall coherence of the standards.

This document presents a collection of assessment items—representative of those that students would see on NWEA® MAP® Growth™ Math assessments—that do these things, and more. The purpose of this collection is to showcase high-quality assessment items and illustrate how the alignment and rigor as intended by CCR standards are reflected in the item content of each grade-level set. Each item is accompanied by a detailed explanation that supports our alignment claims, including descriptors about the levels of rigor. For the purposes of these documents, NWEA has chosen to use the Common Core State Standards for Mathematics as the alignment resource, but teachers should consider the requirements of their individual state's standards. Each grade-level document highlights the critical key knowledge and understandings for that grade, and each item annotation describes how the item is aligned to the standard, how that standard coherently fits in the progression of standards within and across grades, and how the intended mathematical rigor of the standard is reflected in the item.

Grade 7

Alignment, Rigor, Coherence, Focus

The grade 7 items in this document are tightly aligned to the Common Core State Standards, attend to the rigor of the named standards, and can be described in terms of coherence in the standards. This item set is not a comprehensive summative collection of items, a reflection of how items in an assessment should be balanced, or a sample test. When reviewing the items in this set—or any assessment item—consider these important questions regarding alignment, rigor, and coherence:

- **Alignment**—*Do students have to show evidence of the standard to answer the item?*
- **Rigor**—*Does the rigor in the item match the intended rigor in the standard?*
- **Coherence**—*Does the item fit within the coherence of the standards, both between grades and within the grade?*

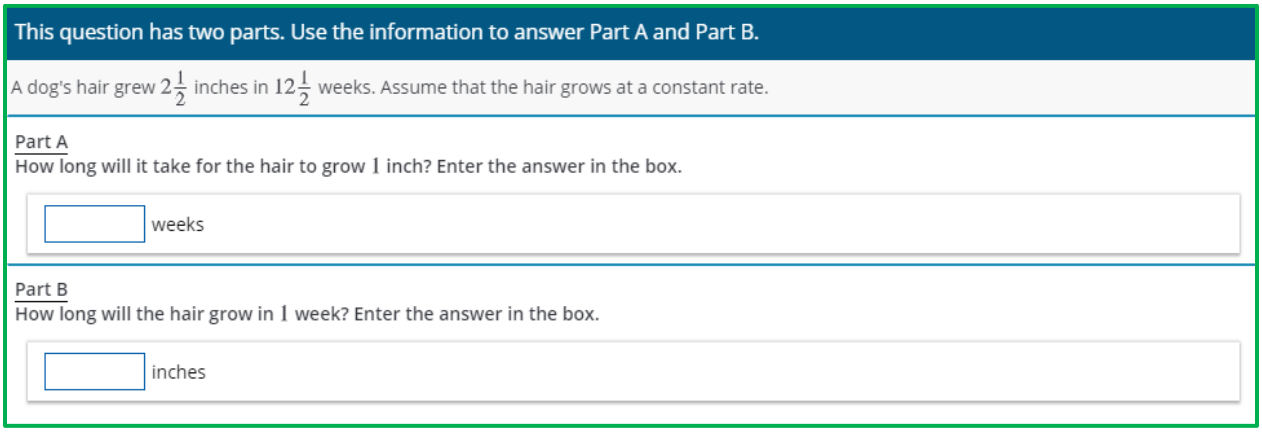
Because K–8 standards are organized by grade, additional consideration should be given to the key knowledge and understandings in each grade. Therefore, it is important to consider how the item connects to the focus areas of the grade.

- **Focus Areas**—*Does the item assess focus areas or support those focus areas in some way?*

The key knowledge and understandings for grade 7 are ratios and proportional relationships, expressions and equations, and arithmetic of rational numbers. Students analyze proportional relationships, connect proportional relationships between quantities to equations and graphs, and identify constants of proportionality, which supports the work they will do with linear functions in future grades. Students are expected to apply arithmetic operations to all forms of rational numbers, including—but not limited to—negative fractions and integers. Problem solving includes an understanding of negative numbers in real-world application settings as well as an expectation for solving multistep problems involving all arithmetic operations and rational numbers. Students should be given many opportunities to write, rewrite, and operate with linear expressions, as well as to represent and solve multistep problems using equations and inequalities of the form $px + q = r$.

Grade 7 Exemplar Item Set

Item 1
Domain: Ratios and Proportional Relationships
7.RP.A: Analyze proportional relationships and use them to solve real-world and mathematical problems.
Calculator Availability: Yes



Alignment: 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.*

Using proportional relationships to solve problems and modeling with mathematics are both foundational for future studies in mathematics and science, and both are used frequently in everyday life. This item challenges students' understanding of the concept of rate by requiring a calculation of rates in two different ways given two mixed numbers.

Coherence: The development of the ratio concept builds on the work of grade 5, when students analyzed patterns and relationships[5.OA.B] and to solve problems involving multiplication and division of fractions.[5.NF.B] In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also in grade 6, students solved problems involving unit rate, and the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] Proportional reasoning builds the foundation for work in grade 8 with linear functions and slope understanding,[8.F.A/B, 8.EE.B] and using quantitative reasoning with units to solve problems.[HSN-Q.A.1]

Rigor: This item attends to conceptual understanding, application, and procedural skill. Students must understand the concept of a rate and reason about how to represent a unit rate in two different ways in a context that is familiar. By grade 7, students have developed a procedure for dividing a fraction by a fraction. The calculator is provided as a tool, which, if used, lessens the procedural complexity of the item.

Answer Key:

This question has two parts. Use the information to answer Part A and Part B.

A dog's hair grew $2\frac{1}{2}$ inches in $12\frac{1}{2}$ weeks. Assume that the hair grows at a constant rate.

Part A

How long will it take for the hair to grow 1 inch? Enter the answer in the box.

5 weeks

Part B

How long will the hair grow in 1 week? Enter the answer in the box.

0.2 inches

Item 2

Domain: Ratios and Proportional Relationships

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

Calculator Availability: Yes

Choose all the tables that represent a proportional relationship between the number of shirts bought and the cost of the shirts.

A.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	5	10	15	20	25

B.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	20	40	70	90	120

C.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	40	80	120	160	200

D.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	50	150	250	350	450

Alignment: 7.RP.A.2a: 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.

Identifying proportional relationships is foundational for future studies in mathematics, including linear functions and geometry. This item requires students to evaluate the given tables to determine which of the relationships are proportional. The values were chosen to keep the mental math relatively easy, though a calculator is available.

Coherence: In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also, in grade 6, students solved problems involving unit rate, and learned the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] This grade 7 standard lays the foundation for understanding relationships as functions and prepares students to graph, compare, and interpret proportional relationships as linear functions in grade 8.[8.F.A/B, 8.EE.B]

Rigor: This item attends to conceptual understanding, application, and procedural skill. Students must understand and recall the concept of a proportional relationship in a familiar context requiring little interpretation. Students use a below grade-level procedure for division or use scaling to determine which sets of values represent proportional relationships. The calculator is provided as a tool, which, if used, lessens the procedural complexity of the item.

Answer Key:

Choose all the tables that represent a proportional relationship between the number of shirts bought and the cost of the shirts.

- [x] A.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	5	10	15	20	25

- [ ] B.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	20	40	70	90	120

- [x] C.

Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	40	80	120	160	200

- [ ] D.

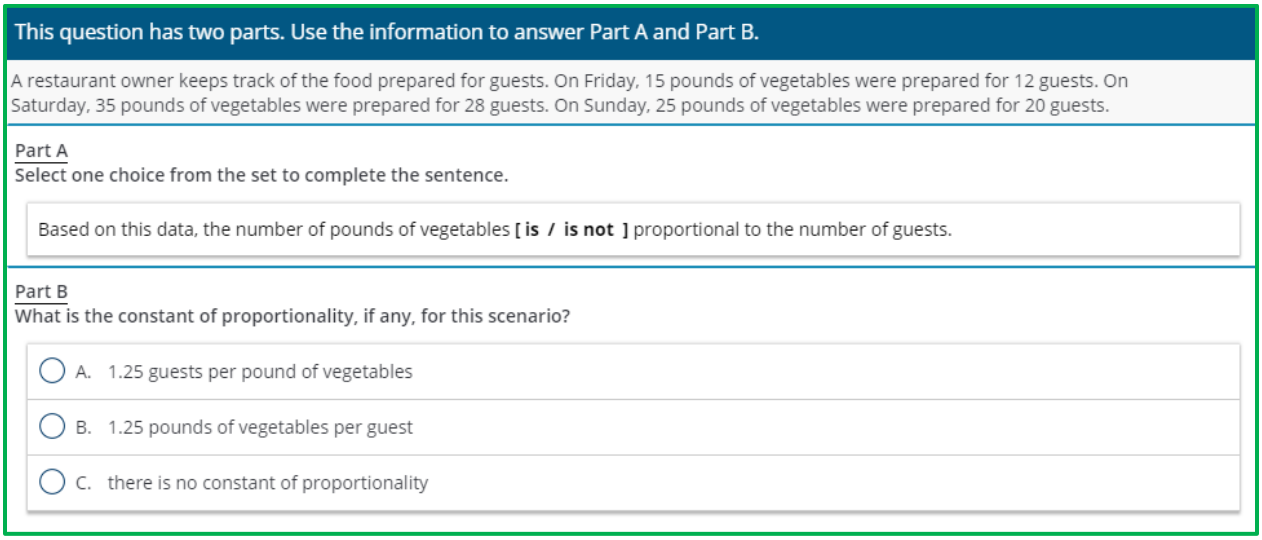
Number of Shirts Bought	5	10	15	20	25
Cost of Shirts ($)	50	150	250	350	450

Item 3

Domain: Ratios and Proportional Relationships

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

Calculator Availability: Yes



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

Using proportional relationships to solve problems and modeling with mathematics are both foundational for future studies in mathematics and science, and both are used frequently in everyday life. This item requires students to interpret the scenario and use the values provided to determine if the relationship is proportional and calculate the constant of proportionality as a unit rate, if it exists.

Coherence: In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also, in grade 6, students solved problems involving unit rate, and the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] This grade 7 standard lays the foundation for understanding relationships as functions and prepares students to graph, compare, and interpret proportional relationships as linear functions in grade 8[8.F.A/B] and to develop an understanding of slope.[8.EE.B]

Rigor: This item attends to conceptual understanding, application, and procedural skill. Students must understand and recall the meaning of a proportional relationship in a familiar scenario that makes the mathematics obvious. Students use a below grade-level procedure of division to determine the constant of proportionality. The calculator is provided as a tool, which, if used, lessens the procedural complexity of the item.

Answer Key:

This question has two parts. Use the information to answer Part A and Part B.

A restaurant owner keeps track of the food prepared for guests. On Friday, 15 pounds of vegetables were prepared for 12 guests. On Saturday, 35 pounds of vegetables were prepared for 28 guests. On Sunday, 25 pounds of vegetables were prepared for 20 guests.

Part A

Select one choice from the set to complete the sentence.

Based on this data, the number of pounds of vegetables [**is** / **is not**] proportional to the number of guests.

Part B

What is the constant of proportionality, if any, for this scenario?

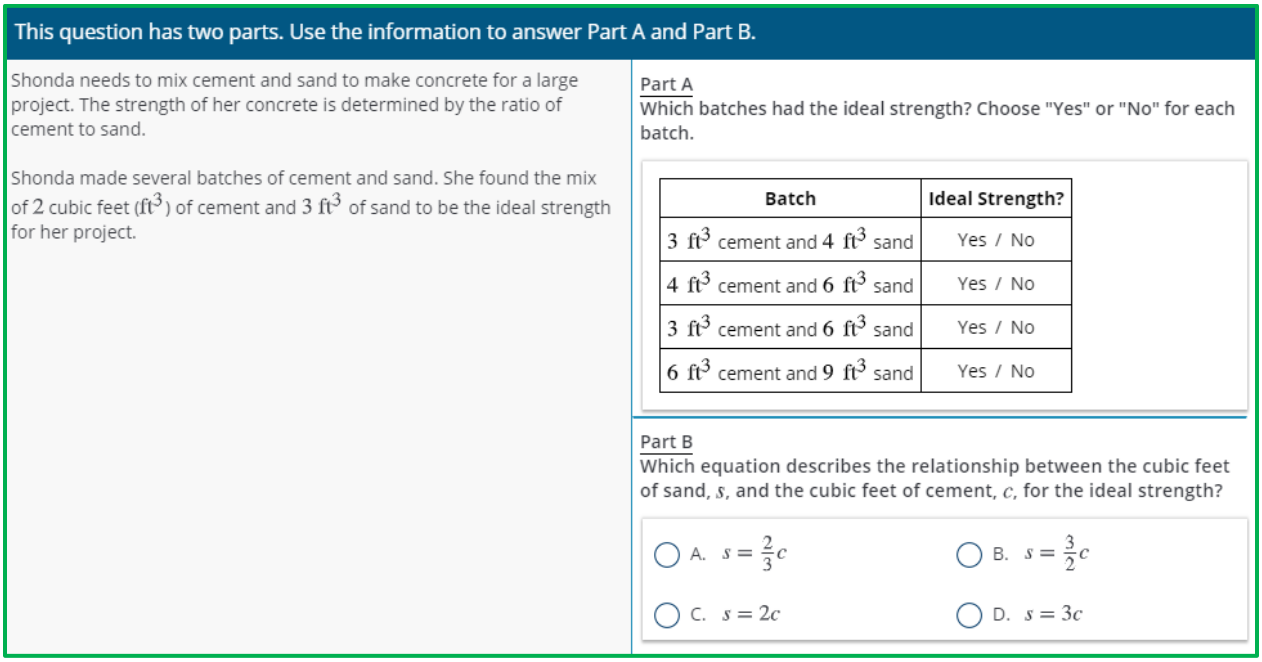
- A. 1.25 guests per pound of vegetables
- B. 1.25 pounds of vegetables per guest
- C. there is no constant of proportionality

Item 4

Domain: Ratios and Proportional Relationships

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

Calculator Availability: No



This question has two parts. Use the information to answer Part A and Part B.

Shonda needs to mix cement and sand to make concrete for a large project. The strength of her concrete is determined by the ratio of cement to sand.

Shonda made several batches of cement and sand. She found the mix of 2 cubic feet (ft^3) of cement and 3 ft^3 of sand to be the ideal strength for her project.

Part A

Which batches had the ideal strength? Choose "Yes" or "No" for each batch.

Batch	Ideal Strength?
3 ft^3 cement and 4 ft^3 sand	Yes / No
4 ft^3 cement and 6 ft^3 sand	Yes / No
3 ft^3 cement and 6 ft^3 sand	Yes / No
6 ft^3 cement and 9 ft^3 sand	Yes / No

Part B

Which equation describes the relationship between the cubic feet of sand, s, and the cubic feet of cement, c, for the ideal strength?

A. $s = \frac{2}{3}c$

B. $s = \frac{3}{2}c$

C. $s = 2c$

D. $s = 3c$

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

Using proportional relationships to solve problems and model with mathematics are both foundational for future study in mathematics and science and used frequently in everyday life. In this item students recognize equivalent ratios, and then translate the relationship into an equation in two given variables. As the amount of cement increases, the amount of sand must increase. Students must identify and compare the given proportional relationships and identify the equation that represents the relationship between the number of parts of cement to the number of parts of sand.

Coherence: In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also in grade 6, students solved problems involving unit rate, and learned the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] This grade 7 standard lays the foundation for understanding relationships as functions and prepares students to graph, compare, and interpret proportional relationships as linear functions in grade 8[8.F.A/B] and develop an understanding of slope.[8.EE.B]

Rigor: This item attends to conceptual understanding and application. Students must recognize equivalent ratios and identify an equation that describes the given relationship between cubic feet of cement and cubic feet of sand for the ideal concrete strength. Students must interpret the context in order to determine the concepts necessary to solve the problem.

Answer Key:

This question has two parts. Use the information to answer Part A and Part B.

Shonda needs to mix cement and sand to make concrete for a large project. The strength of her concrete is determined by the ratio of cement to sand.

Shonda made several batches of cement and sand. She found the mix of 2 cubic feet (ft^3) of cement and 3 ft^3 of sand to be the ideal strength for her project.

Part A

Which batches had the ideal strength? Choose "Yes" or "No" for each batch.

Batch	Ideal Strength?
3 ft^3 cement and 4 ft^3 sand	Yes / **No**
4 ft^3 cement and 6 ft^3 sand	**Yes** / No
3 ft^3 cement and 6 ft^3 sand	Yes / **No**
6 ft^3 cement and 9 ft^3 sand	**Yes** / No

Part B

Which equation describes the relationship between the cubic feet of sand, s, and the cubic feet of cement, c, for the ideal strength?

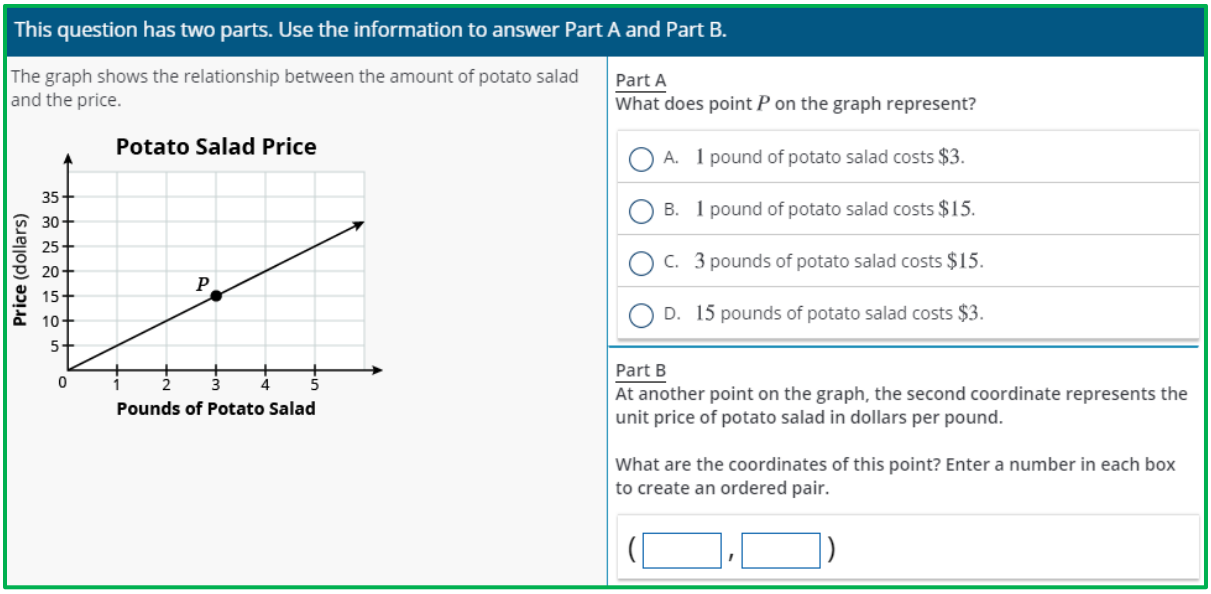
- A. $s = \frac{2}{3}c$
- **B. $s = \frac{3}{2}c$**
- C. $s = 2c$
- D. $s = 3c$

Item 5

Domain: Ratios and Proportional Relationships

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

Calculator Availability: No



Alignment: 7.RP.A.2d 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.

Using proportional relationships to solve problems and modeling with mathematics are both foundational for future study in mathematics and science, and both are used frequently in everyday life. This two-part item requires students to interpret the meaning of a point (x, y) on the graph of a proportional relationship and to recognize that r in the point (1, r) is the unit rate.

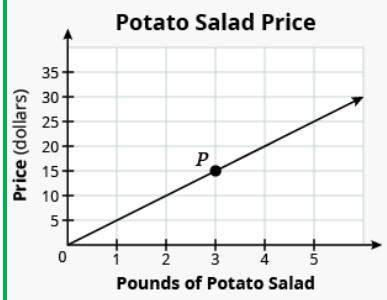
Coherence: In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also in grade 6, students solved problems involving unit rate, and the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] Parts c and d of this grade 7 standard[7.RP.A.2.c/d] help to lay the foundation for translation between different representations of linear relationships in grade 8[8.F.A/B] and develop an understanding of slope.[8.EE.B]

Rigor: This item attends to conceptual understanding and application. Students must understand what the point (3, 15) on the graph means in terms of the scenario and then use the definition of unit rate to determine the location of the point that represents the unit rate in the same scenario. In this item, the mathematics is not directly indicated and requires students to interpret the real-world scenario and use the information in the problem to decide how to solve.

Answer Key:

This question has two parts. Use the information to answer Part A and Part B.

The graph shows the relationship between the amount of potato salad and the price.



Part A

What does point P on the graph represent?

- A. 1 pound of potato salad costs $3.
- B. 1 pound of potato salad costs $15.
- C. 3 pounds of potato salad costs $15. (selected)
- D. 15 pounds of potato salad costs $3.

Part B

At another point on the graph, the second coordinate represents the unit price of potato salad in dollars per pound.

What are the coordinates of this point? Enter a number in each box to create an ordered pair.

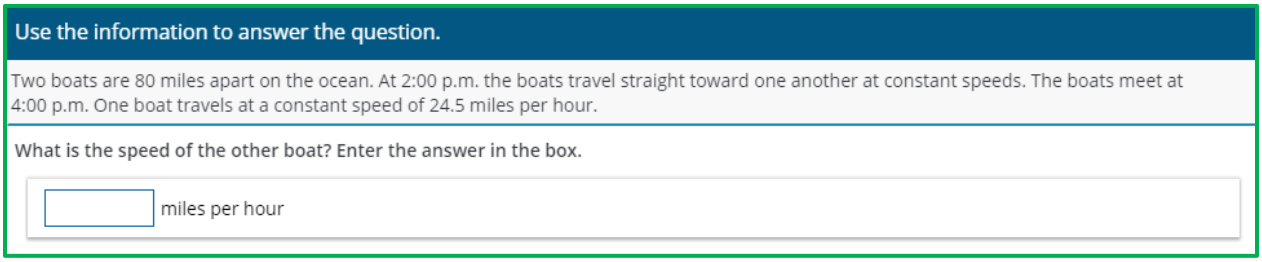
(1 , 5)

Item 6

Domain: Ratios and Proportional Relationships

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

Calculator Availability: Yes



Alignment: 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.*

Using proportional relationships to solve problems and modeling with mathematics are both foundational for future studies in mathematics and science, and both are used frequently in everyday life. In this item, students solve a multistep word problem involving rates, where students must understand the proportional relationship between distance and time. Because the necessary mathematics isn't directly indicated in the item, there are multiple solution paths. Students may use the speed and time (2 hours) to calculate the distance traveled by one boat as 49 miles, then find that the distance traveled by the other boat was 31 miles, and then reason that the speed of the second boat is 15.5 miles per hour. Students may also set up an equation, $24.5(2) + 2x = 80$, and solve for the unknown speed.

Coherence: In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also in grade 6, students solved problems involving unit rate, and the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] In grade 7, students complete their work in ratio and proportion by using proportional relationships to solve multistep ratio and percent problems, laying the foundation for understanding relationships as functions to prepare students to graph, compare, and interpret proportional relationships as linear functions in grade 8[8.F.A/B] and develop an understanding of slope.[8.EE.B]

Rigor: This item attends to conceptual understanding, application, and procedural skill. Students must relate the concepts of distance and time to the concept of speed as a rate. The required mathematics is not directly indicated in the scenario and requires students to interpret the real-world scenario and use the information in the problem to decide how to solve the item. Students use below grade-level operations to arrive at a solution, and the calculator is provided as a tool, which, if used, lessens the procedural complexity of the item.

Answer Key:

Use the information to answer the question.

Two boats are 80 miles apart on the ocean. At 2:00 p.m. the boats travel straight toward one another at constant speeds. The boats meet at 4:00 p.m. One boat travels at a constant speed of 24.5 miles per hour.

What is the speed of the other boat? Enter the answer in the box.

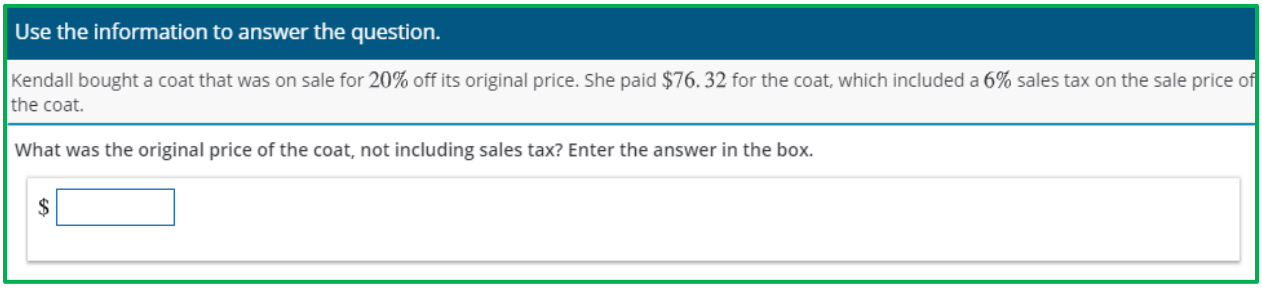
15.5 miles per hour

Item 7

Domain: Ratios and Proportional Relationships

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

Calculator Availability: Yes



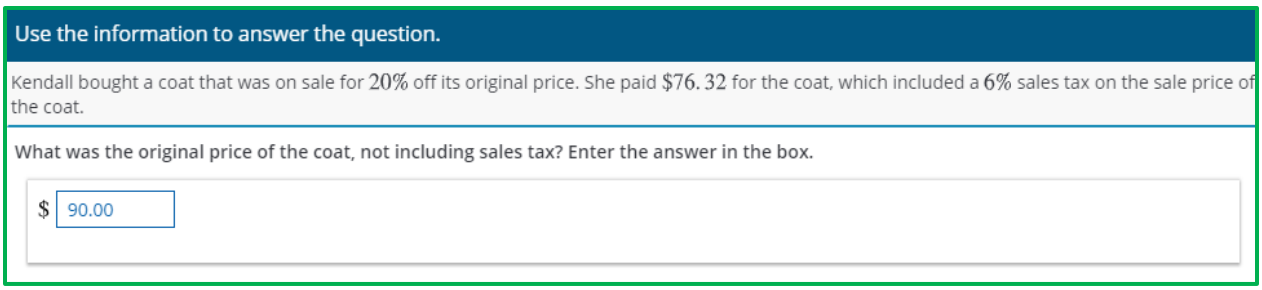
Alignment: 7.RP.A.3: Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

Using proportional relationships to solve problems and modeling with mathematics are both foundational for future studies in mathematics and science, and both are used frequently in everyday life. In this item, students must solve a multistep word problem involving percents.

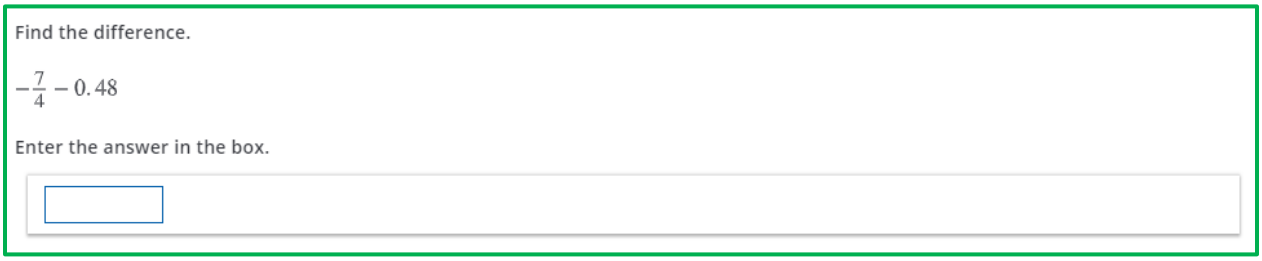
Coherence: In grade 6, students were introduced to the concept of ratios and began calculating unit rates with whole numbers. Also in grade 6, students solved problems involving unit rate, and the equivalent terms *for every*, *for each*, *for each 1*, and *per* were established and used.[6.RP.A] In grade 7, students complete their work in ratio and proportion by using proportional relationships to solve multistep ratio and percent problems, laying the foundation for understanding relationships as functions to prepare students to graph, compare, and interpret proportional relationships as linear functions in grade 8[8.F.A/B] and develop an understanding of slope.[8.EE.B]

Rigor: This item attends to conceptual understanding, application, and procedural skill. Rather than simply find the percent of a whole number, students must demonstrate a more sophisticated conceptual understanding and reasoning in order to calculate the original price as specified in the item. While the context may be familiar, it requires some interpretation as the mathematics is not directly indicated in the item. The procedures for multiplying whole numbers by decimals, or operating with whole numbers, should be well-established, and the calculator is provided as a tool, which, if used, lessens the procedural complexity of the item.

Answer Key:



Item 8
Domain: The Number System
7.NS.A: Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
Calculator Availability: No



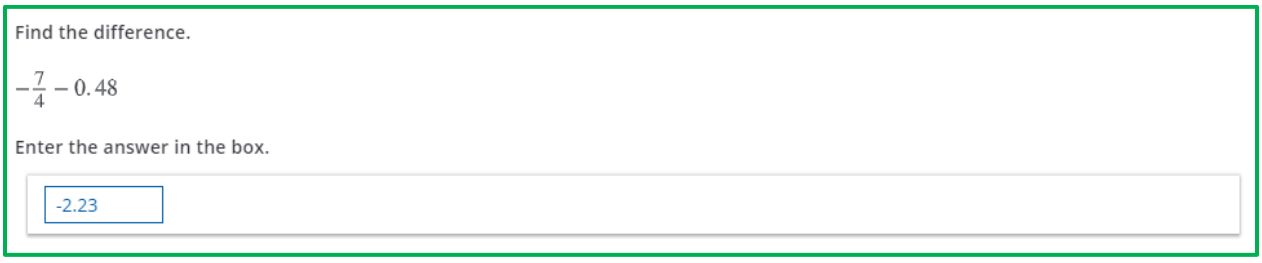
Alignment: 7.NS.A.1: Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.

Operating with rational numbers is an important part of the K–8 progression. The numbers and operations in this item were chosen to illustrate the grade-level expectation for addition and subtraction with rational numbers. This item requires students to subtract a decimal number from a negative fraction. Students can use their understanding of positioning on a number line or rules for operating with signed numbers, along with converting a fraction to a decimal or a decimal to a fraction in order to carry out the computations.

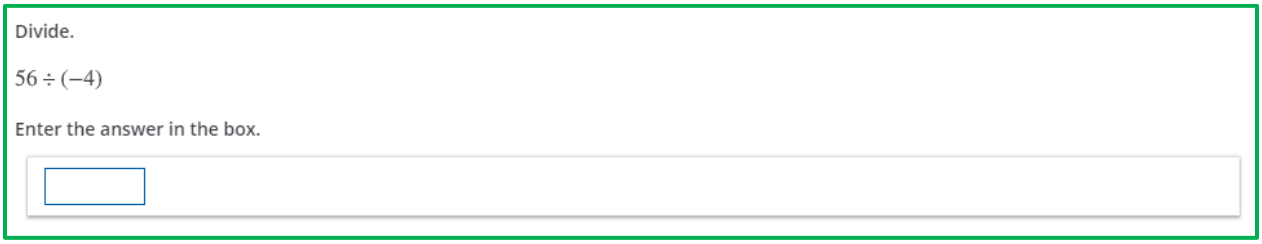
Coherence: Students should be given opportunities to work toward fluency throughout instruction. Students began developing computational strategies as early as kindergarten and continue to develop strategies through grade 7. Grade 6 has the final standard in a progression of decimal number operations[6.NS.B.3] that began in grade 4.[4.NF.A.6] In grade 7, students apply and extend their understandings of using equivalent fractions as a strategy for addition and subtraction of fractions [5.NF.A] and work with the number line below zero[6.NS.C.6] to compute with negative rational numbers. Computation with rational numbers supports grade 7 work with expressions and equations,[7.EE.A/B] and prepares students for work with computing with scientific notation,[8.EE.A.4] and understanding the work with irrational numbers.[8.NS.A]

Rigor: This item attends to procedural skill. Students have developed grade-level procedures for operating with rational numbers in different forms, including signed numbers, and call upon those algorithms to compute.

Answer Key:



Item 9
Domain: The Number System
7.NS.A Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
Calculator Availability: No



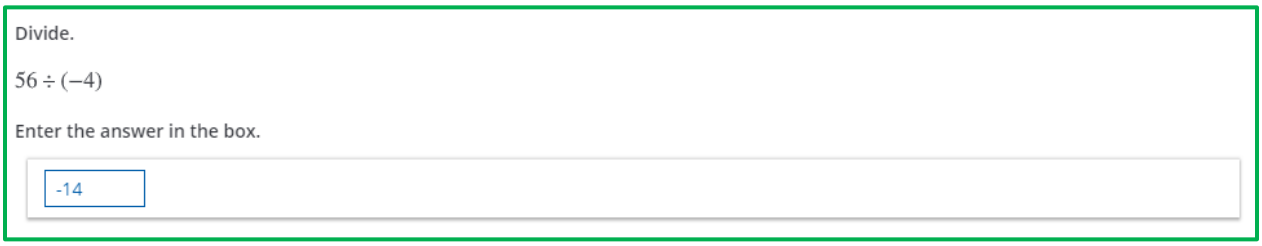
Alignment: 7.NS.A.2: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.

Operating with rational numbers is an important part of the K–8 progression. The numbers and operations in this item were chosen to illustrate the grade-level expectation for multiplication and division with integers. This item requires students to know the rules for operations with signed numbers.

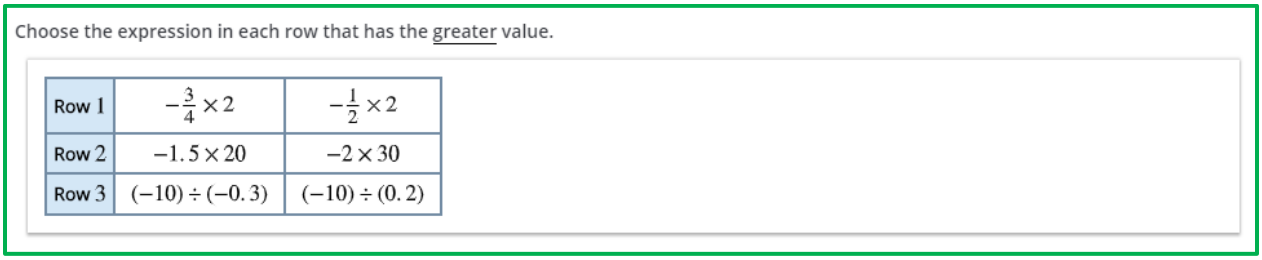
Coherence: Students should be given opportunities to work towards fluency throughout instruction. Students began developing computational strategies as early as kindergarten and continue to develop strategies through grade 7. In grade 6, students began to develop the concept of negative rational numbers and work with the number line below zero.[6.NS.C.6] In grade 7, students must apply and extend their understandings of negative numbers to compute with rational numbers of all forms. Computation with rational numbers supports grade 7 work with expressions and equations,[7.EE.A/B] and prepares students for work with computing with scientific notation,[8.EE.A.4] and understanding the work with irrational numbers. [8.NS.A]

Rigor: This item attends to procedural skill. Students have developed grade-level procedures for operating with rational numbers in different forms, including signed numbers, and call upon those algorithms to compute.

Answer Key:



Item 10
Domain: The Number System
7.NS.A Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
Calculator Availability: No


Choose the expression in each row that has the greater value.

Row 1	$-\frac{3}{4} \times 2$	$-\frac{1}{2} \times 2$
Row 2	-1.5×20	-2×30
Row 3	$(-10) \div (-0.3)$	$(-10) \div (0.2)$

Alignment: 7.NS.A.2: Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.

Operating with rational numbers is an important part of the K–8 progression. The numbers and operations in this item were chosen to illustrate the grade-level expectation for multiplication and division with rational numbers in different forms. The expressions in this item are crafted so that students can leverage their knowledge of structure and the rules for operating with rational numbers to determine which has the greater value without executing any computations.

Coherence: Students should be given opportunities to work toward fluency throughout instruction. Students began developing computational strategies as early as kindergarten and continue to develop strategies through grade 7. This item extends the understanding developed around multiplication as scaling[5.NF.B.5] and the of concept of negative rational numbers[6.NS.C.6] to the full rational number system. In grade 7, students must apply and extend their understandings of negative numbers to compute with rational numbers of all forms. Computation with rational numbers supports grade 7 work with expressions and equations,[7.EE.A/B] and prepares students for work with computing with scientific notation,[8.EE.A.4] and understanding the work with irrational numbers. [8.NS.A]

Rigor: This item attends to conceptual understanding and procedural skill. Depending on how students approach this item, they may use conceptual understanding of multiplication and division of decimals and fractions, and the rules for multiplication and division with signed numbers, to reason about the resulting magnitude without actually computing. Alternatively, students have developed grade-level procedures for operating with rational numbers in different forms, including signed numbers, and may call upon those algorithms to compute. No calculator tool is provided to reinforce reasoning without computation.

Answer Key:

Choose the expression in each row that has the greater value.

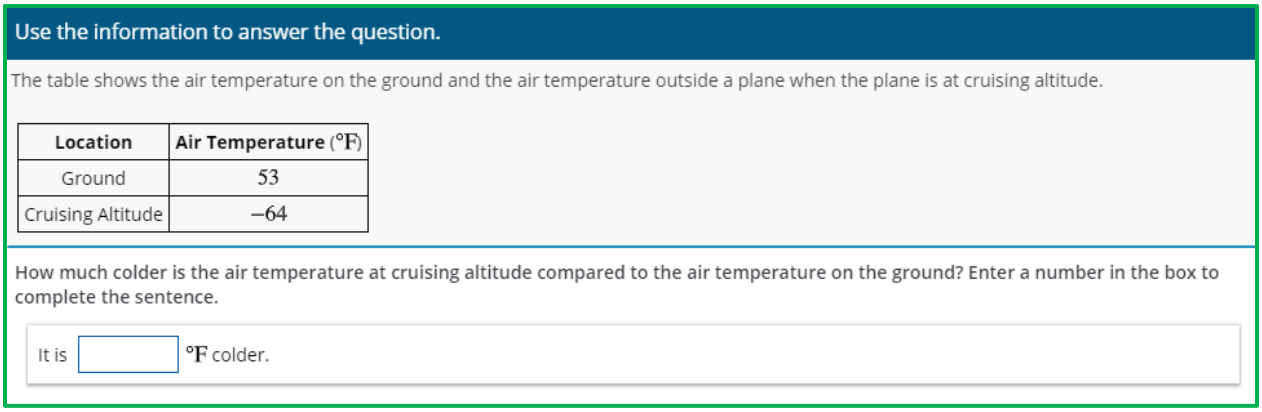
Row 1	$-\frac{3}{4} \times 2$	$-\frac{1}{2} \times 2$
Row 2	-1.5×20	-2×30
Row 3	$(-10) \div (-0.3)$	$(-10) \div (0.2)$

Item 11

Domain: The Number System

7.NS.A Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

Calculator Availability: No



Use the information to answer the question.

The table shows the air temperature on the ground and the air temperature outside a plane when the plane is at cruising altitude.

Location	Air Temperature (°F)
Ground	53
Cruising Altitude	−64

How much colder is the air temperature at cruising altitude compared to the air temperature on the ground? Enter a number in the box to complete the sentence.

It is [ ] °F colder.

Alignment: 7.NS.A.3: Solve real-world and mathematical problems involving the four operations with rational numbers.

Operating with rational numbers is an important part of the K–8 progression. In this item, students are asked to solve a word problem by operating with a positive and a negative integer. The numbers and operations in the item were chosen to illustrate the grade-level expectation for subtraction with integers.

Coherence: Students should be given opportunities to work toward fluency throughout instruction. Students began developing computational strategies as early as kindergarten and continue to develop strategies through grade 7. In grade 6, students began to develop the concept of negative rational numbers and work with the number line below zero.[6.NS.C.6] In grade 7, students apply and extend their understandings of negative numbers to compute with rational numbers of all forms. Computation with rational numbers supports grade 7 work with expressions and equations,[7.EE.A/B] and prepares students for work with computing with scientific notation,[8.EE.A.4] and understanding the work with irrational numbers.[8.NS.A]

Rigor: This item attends to procedural skill and application. Students have developed grade-level procedures for operating with rational numbers in different forms, including signed numbers, and call upon those algorithms to compute. The real-world scenario gives meaning to the operations, and the mathematics is directly indicated by the context.

Answer Key:

Use the information to answer the question.

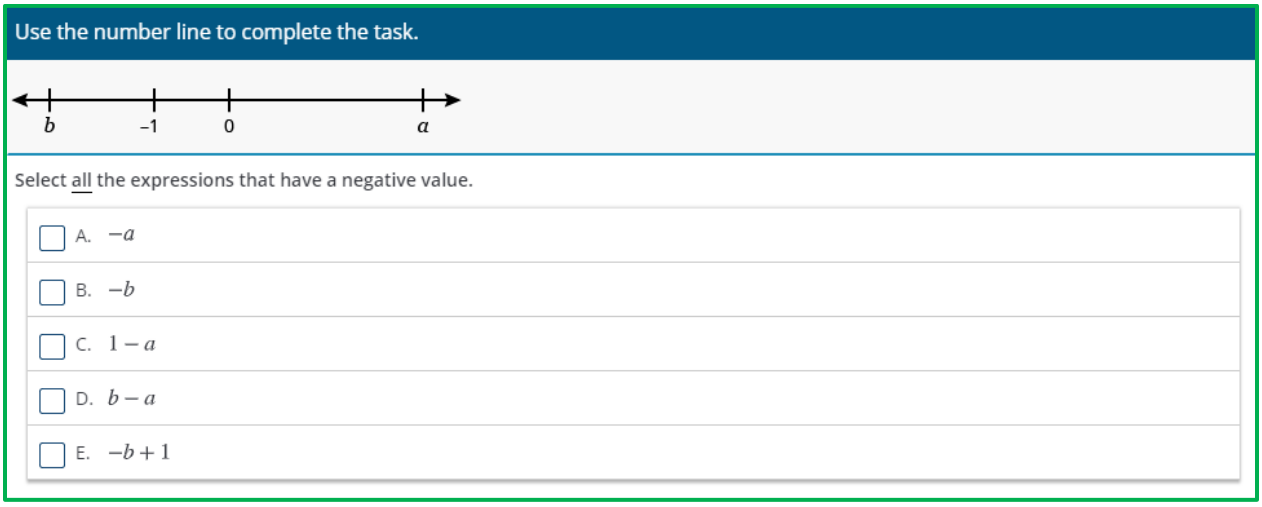
The table shows the air temperature on the ground and the air temperature outside a plane when the plane is at cruising altitude.

Location	Air Temperature (°F)
Ground	53
Cruising Altitude	−64

How much colder is the air temperature at cruising altitude compared to the air temperature on the ground? Enter a number in the box to complete the sentence.

It is 117 °F colder.

Item 12
Domain: The Number System
7.NS.A Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.
Calculator Availability: No



Alignment: 7.NS.A.1: 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.

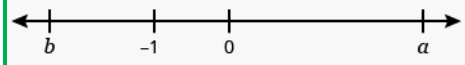
Understanding the meaning of operations with rational numbers is an important part of grade 7 work. The use of variables to represent values in this item were chosen to illustrate the grade-level expectation for further developing the meaning of operations with rational numbers and the magnitudes of the results. The expressions in this item are crafted so that students can leverage their knowledge of structure and the rules for operating with rational numbers to decide on the positioning without executing any specific computations.

Coherence: Students began work with the horizontal number line in grade 2, using it as a tool to order whole numbers, and extend that knowledge in grades 4 and 5 to order fractions[4.NF.A] and decimals.[5.NBT.A.3] In grade 6, students learned that there is a number system that includes both positive and negative numbers, and that the distance from zero is a measure of magnitude, known as absolute value.[6.NS.A] This knowledge is foundational for the continued work in grade 7 in the rational number system including representation and operations with rational numbers.[7.NS.A] Computation with rational numbers supports the work across domains,[7.EE.A/B] and prepares students for work with computing with scientific notation,[8.EE.4] and understanding the work with irrational numbers.[8.NS.A]

Rigor: This item attends to conceptual understanding. Students are asked to use their understanding of operations with negative rational numbers to determine the resulting magnitude without computing. Variables are used so that students must engage in reasoning as they relate concepts of positioning on a number line and rules for operating with negative numbers, without using a procedure.

Answer Key:

Use the number line to complete the task.



Select all the expressions that have a negative value.

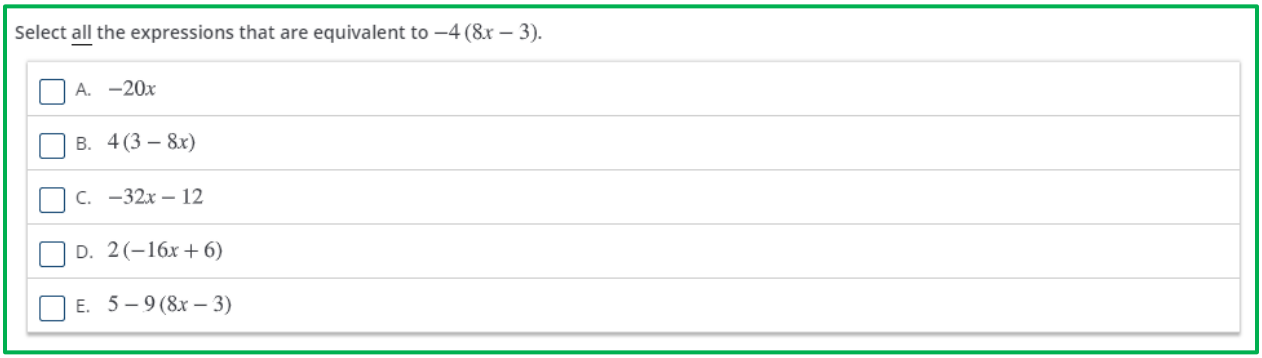
- [x] A. $-a$
- [ ] B. $-b$
- [x] C. $1-a$
- [x] D. $b-a$
- [ ] E. $-b+1$

Item 13

Domain: Expressions and Equations

7.EE.A: Use properties of operations to generate equivalent expressions.

Calculator Availability: No



Alignment: 7.EE.A.1: Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

Operating with expressions is foundational for work with algebra in later grades. This item requires students to apply their knowledge of the distributive property, commutative property, and properties of operations to identify equivalent expressions. The use of negative integers reinforces the grade level expectation for operating with rational numbers in all forms.

Coherence: In grade 5, students became more familiar with grouping symbols within numerical expressions.[5.OA.A.1] In grade 6, students extended properties of numerical operations to properties of algebraic operations to transform and manipulate simple expressions.[6.EE.A.3] In grade 7, students start to simplify more complex linear expressions with rational coefficients, including those whose transformation may require understanding of rules for operating with negative numbers.[7.EE.A.1] In grade 8, students will apply this knowledge to solving more complex equations.[8.EE.B.7]

Rigor: This item attends to conceptual understanding and procedural skill. Students must relate the concept of equivalence with the commutative and distributive properties. Students operates with negative integers as a grade-level procedural skill to arrive at the solution. Because the use of negative integers reinforces the grade level expectation for operating with rational numbers in all forms, no calculator tool is provided.

Answer Key:

Select all the expressions that are equivalent to $-4\,(8x-3)$.

- [ ] A. $-20x$
- [x] B. $4\,(3-8x)$
- [ ] C. $-32x-12$
- [x] D. $2\,(-16x+6)$
- [ ] E. $5-9\,(8x-3)$

Item 14

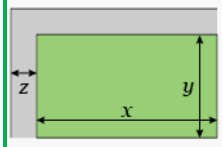
Domain: Expressions and Equations

7.EE.A: Use properties of operations to generate equivalent expressions.

Calculator Availability: No

Use the information to answer the question.

The picture shows a playground with its length (x) and width (y) marked. A path runs along two sides of the playground. The width of the path (z) is the same on both sides of the playground.



Three students found formulas to calculate the area of the path that runs along the two sides of the playground. Each student came up with a different—but equivalent—expression to correctly find the total area of the path along the playground.

Which expression represents each student strategy? Move each expression into the table next to the student strategy it represents.

Student Strategy	Expression
Gina found the area of the path along each side of the playground and then added the area of the corner.	
Jason found the area of the playground and the path and then removed the area of the playground.	
Lydia found the areas of the vertical and horizontal path and then removed the area of the overlapping corner.	

$(x + z) \cdot (y + z) - (x \cdot y)$

$(x \cdot z) + (y \cdot z) + (z \cdot z)$

$(x + z) \cdot (z) + (y + z) \cdot (z) - (z \cdot z)$

Alignment: **7.EE.A.2:** Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*

Operating with expressions is built from operations with numbers. Understanding that expressions in different forms can illuminate how quantities are related in a real-world setting is foundational for work with algebra in the later grades. This item highlights the fact that different approaches to the same problem result in different, but equivalent, forms of an expression that represent the same quantity. In order to answer correctly, students must have correctly interpreted each of the presented strategies in the context of the problem to appropriately match the strategy and expression.

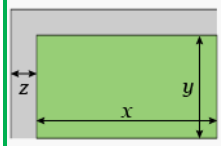
Coherence: In grade 5, students became more familiar with grouping symbols within numerical expressions.[5.OA.A.1] In grade 6, students extended properties of numerical operations to properties of algebraic operations to transform and manipulate simple expressions.[6.EE.A.3] In grade 7, students use more complex linear expressions to model quantities in different, but equivalent ways. Students will apply this knowledge to solve more complex equations,[8.EE.B.7] and extend the use of these strategies to model with mathematics in high school.[HSA-SSE.A.1]

Rigor: This item attends to conceptual understanding and application. Students must relate their understanding of equivalent expressions as representations for real-world relationships to arrive at a solution. This item requires an application of mathematics in a real-world scenario where students must interpret and reason about the context in order to solve.

Answer Key:

Use the information to answer the question.

The picture shows a playground with its length (x) and width (y) marked. A path runs along two sides of the playground. The width of the path (z) is the same on both sides of the playground.

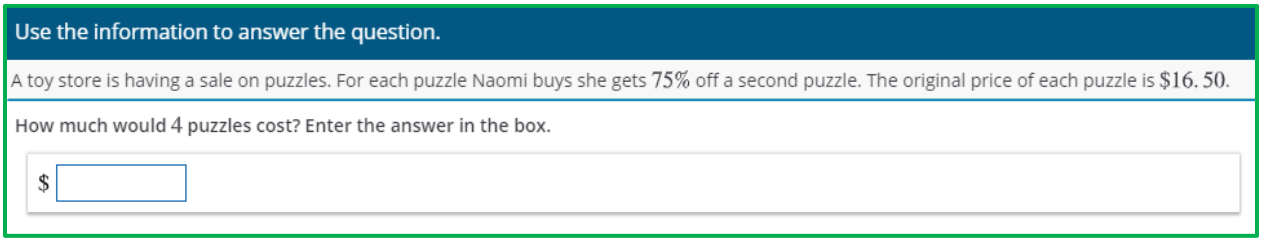


Three students found formulas to calculate the area of the path that runs along the two sides of the playground. Each student came up with a different—but equivalent—expression to correctly find the total area of the path along the playground.

Which expression represents each student strategy? Move each expression into the table next to the student strategy it represents.

Student Strategy	Expression
Gina found the area of the path along each side of the playground and then added the area of the corner.	$(x \cdot z) + (y \cdot z) + (z \cdot z)$
Jason found the area of the playground and the path and then removed the area of the playground.	$(x + z) \cdot (y + z) - (x \cdot y)$
Lydia found the areas of the vertical and horizontal path and then removed the area of the overlapping corner.	$(x + z) \cdot (z) + (y + z) \cdot (z) - (z \cdot z)$

Item 15
Domain: Expressions and Equations
7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
Calculator Availability: Yes



Alignment: 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.

Solving problems and computing fluently with rational numbers is an important part of the K–8 progression. Students can approach the solution through computation or by applying algebraic reasoning to create an expression that can be used to determine the price for four puzzles. Students may choose to model the situation using the numerical expression ((16.50)+(0.25x16.50))(2) or they may combine values to create a different, yet equivalent, expression (2)(16.50)(1.25).

Coherence: In grade 5, students become more familiar with grouping symbols within numerical expressions.[5.OA.A.1] In grade 6, students extend properties of numerical operations to properties of algebraic operations to transform and manipulate simple expressions.[6.EE.A.3] In grade 7, students use more complex linear expressions to model situations in different, but equivalent ways. Students will apply this knowledge to solve more complex linear equations,[8.EE.B.7] and extend the use of these strategies to model with mathematics in high school. [HSA-SSE.A.1]

Rigor: This item attends to conceptual understanding, procedural skill, and application. Students must connect concepts with strategy to determine an approach to solve. Students then use properties of operations with rational numbers and algebraic properties to arrive at a solution and the calculator is provided as a tool, which, if used, lessens the procedural complexity of the item. This item requires an application of mathematics in a real-world scenario where students must interpret and reason about the context in order to solve.

Answer Key:

Use the information to answer the question.

A toy store is having a sale on puzzles. For each puzzle Naomi buys she gets 75% off a second puzzle. The original price of each puzzle is $\$16.50$.

How much would 4 puzzles cost? Enter the answer in the box.

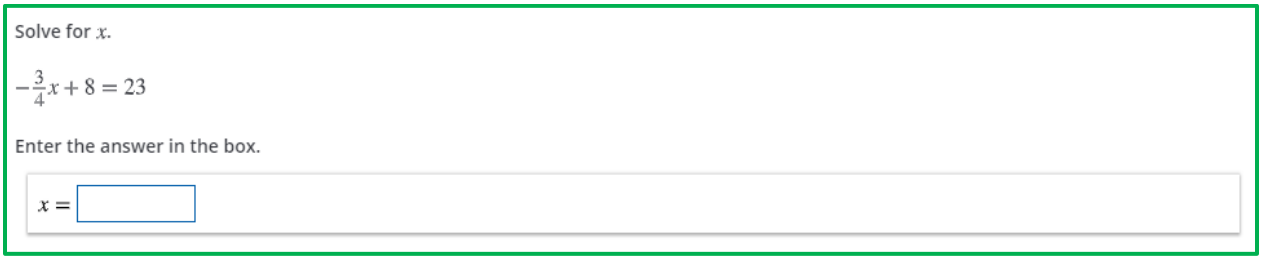
$ 41.25

Item 16

Domain: Expressions and Equations

7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Calculator Availability: Yes



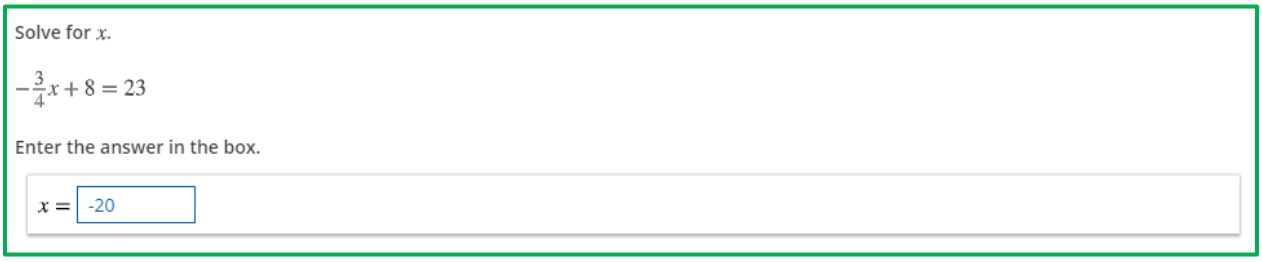
Alignment: 7.EE.B.4a: Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

This item targets the part of the standard about fluently solving equations of the form px + q = r. Solving equations fluently using algebraic reasoning is an important part of the work of grade 7, and not all items need to be grounded in application (word problems). A negative fraction was chosen for the coefficient to reinforce the grade level expectation of operating with rational numbers fluently.

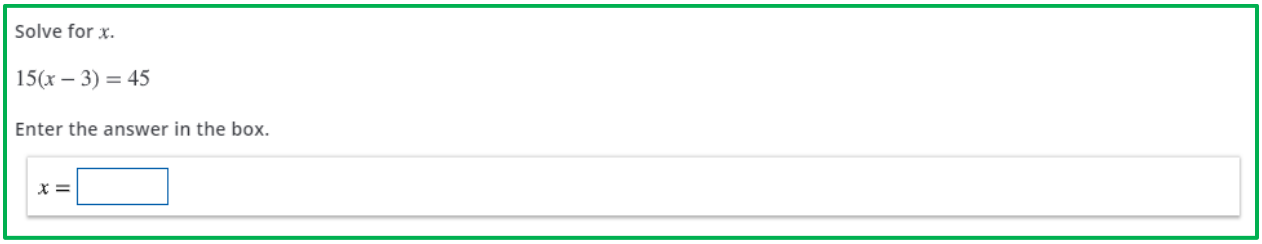
Coherence: Throughout grades K–5, students developed their algebraic reasoning skills by solving simple equations with unknowns in all positions. In grade 6, the concept of a variable was introduced and students solved one-step equations.[6.EE.B.7] In grade 7, students are extending this work beyond one-step equations and inequalities.[7.EE.B.4] Students will further apply this knowledge to solve more complex linear equations in grade 8[8.EE.B.7] and extend the use of these strategies to solve non-linear equations in high school.[HSA-REI.A/B]

Rigor: This item attends to procedural skill. Students have developed grade-level procedures for operating with rational numbers in different forms and for solving equations of the form px + q = r. The calculator is provided as a tool, which, if used, lessens the procedural complexity of the item

Answer Key:



Item 17
Domain: Expressions and Equations
7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
Calculator Availability: Yes



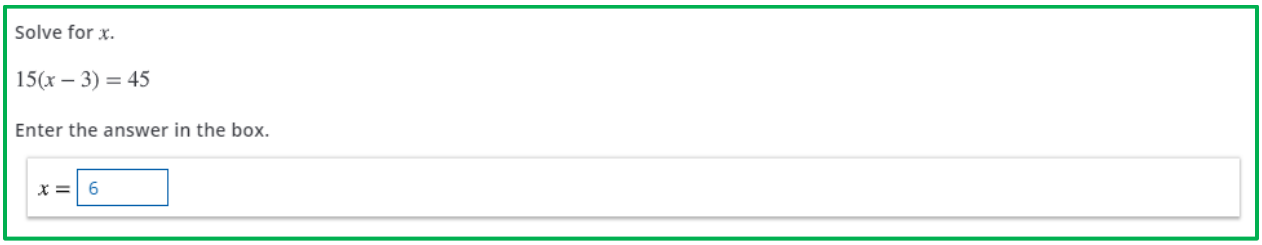
Alignment: 7.EE.B.4a: Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

This item targets the part of the standard about fluently solving equations of the form p(x + q) = r. Solving equations fluently using algebraic reasoning is an important part of the work of grade 7, and not all items need to be grounded in application (word problems). The numbers selected in this item lend themselves towards solving using various approaches. Solving is a process of reasoning to find the numbers which make an equation true, and students should be introduced to examples where looking for structure pays off. For example, in the equation 2x + 8x = 8x + 20, students may recognize that 2x must be equal to 20 to make the two sides equal. In this item, students may use the structure of the equation to either divide 45/15 first or distribute the 15 on the left-hand side of the equation.

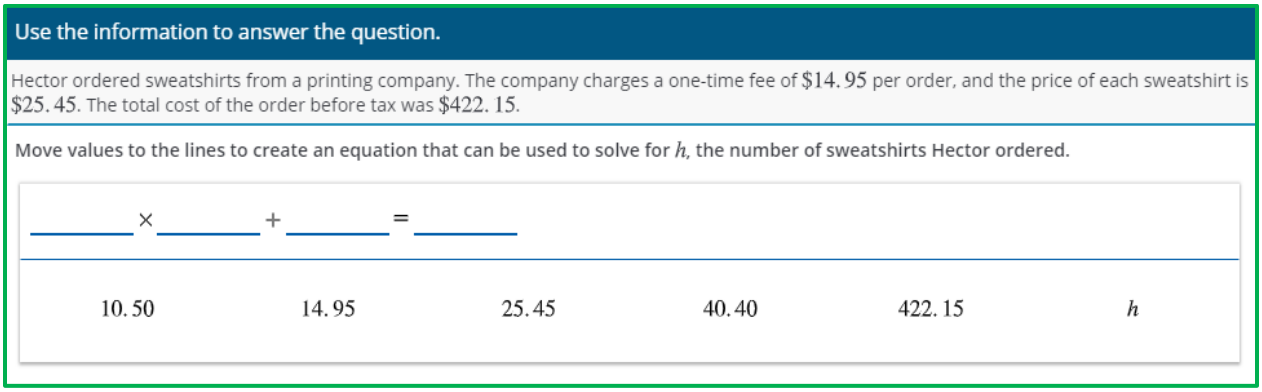
Coherence: Throughout grades K–5, students developed their algebraic reasoning skills by solving simple equations with unknowns in all positions. In grade 6, the concept of a variable was introduced and students solved one-step equation.[6.EE.B.7] In grade 7, students are extending this work beyond one-step equations and inequalities.[7.EE.B.4] Students will further apply this knowledge to solve more complex linear equations in grade 8[8.EE.B.7] and extend the use of these strategies to solve non-linear equations in high school.[HSA-REI.A/B]

Rigor: This item attends to procedural skill. Students have developed grade-level procedures for operating with rational numbers in different forms and for solving equations of the form p(x + q) = r. The calculator is provided as a tool, which, if used, lessens the procedural complexity of the item

Answer Key:



Item 18
Domain: Expressions and Equations
7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
Calculator Availability: Yes



Alignment: 7.EE.B.4a: 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.

Understanding and representing real-world relationships between quantities is a useful everyday skill and is essential as students prepare to model with mathematics and solve more complex problems. This item requires students to interpret the context in order to write an equation that could be used to solve for a specific defined value but does not ask the student to solve the equation. This item specifically focuses on application (word problem) of mathematics in a real-world context. Students must reason about the relationship between the one-time fee and the price of each sweatshirt as it relates to the total cost of the order. The numbers used in this item were intentionally chosen for an algebraic approach to be the most efficient solution path.

Coherence: Throughout grades K–5, students used expressions to represent word problems in the Operations and Algebraic Thinking domain. In grade 6, students needed to not only translate a verbal description to an algebraic expression, but also understand the meaning of the variable.[6.EE.B] In grade 7, students are extending this work beyond one-step equations and inequalities.[7.EE.B.4] Students will further apply this knowledge to create and solve more complex linear equations in grade 8[8.EE.B.7] and extend the use of these strategies to create non-linear equations in high school.[HSA-CED.A]

Rigor: This item attends to conceptual understanding and application. Students must use the concept of a variable in an equation of the form px + q = r to represent the relationship between the given quantities. This item requires mathematics that is directly indicated in the context of a real-world scenario.

Answer Key: There are multiple equivalent correct responses. One sample correct response is shown.

Use the information to answer the question.

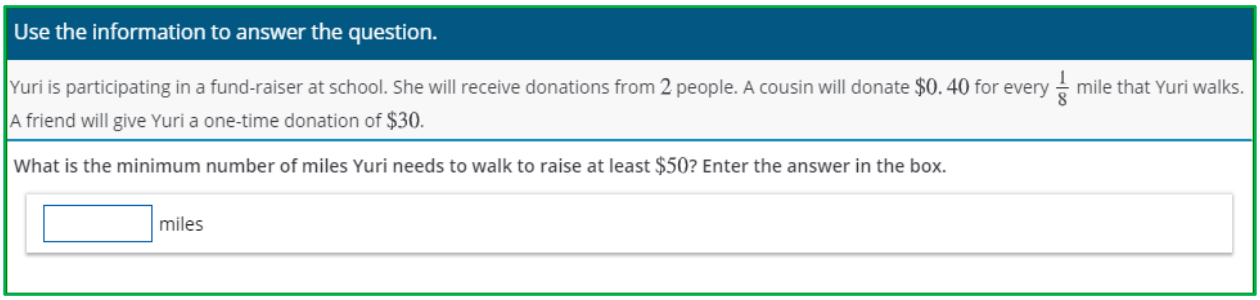
Hector ordered sweatshirts from a printing company. The company charges a one-time fee of $\$14.95$ per order, and the price of each sweatshirt is $\$25.45$. The total cost of the order before tax was $\$422.15$.

Move values to the lines to create an equation that can be used to solve for h, the number of sweatshirts Hector ordered.

$25.45 \times h + 14.95 = 422.15$

10.50 40.40

Item 19
Domain: Expressions and Equations
7.EE.B: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
Calculator Availability: Yes



Alignment: 7.EE.B.4b: 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.

Understanding and representing real-world relationships between quantities is a useful everyday skill and is essential as students prepare to model and solve more complex problems. This item specifically focuses on application of mathematics in a real-world context. The mixed use of rational numbers was intentional and creates a challenging problem that encourages an algebraic approach to the problem. Students can construct a simple inequality by using the $0.40 for every 1/8 mile to write an inequality such as $3.20x + 30 \geq 50$.

Coherence: Throughout grades K–5, students used expressions to represent word problems in the Operations and Algebraic Thinking domain. In grade 6, the concept of a variable was introduced and students solved one-step equations and inequalities.[6.EE.B] In grade 7, students are extending this work beyond one-step equations and inequalities.[7.EE.B.4] Students will further apply this knowledge to create and solve more complex linear equations in grade 8[8.EE.B.7] and extend the use of these strategies to solve non-linear inequalities in high school.[HSA-REI.A/B]

Rigor: This item attends to procedural skill and application. Students have developed grade-level procedures for operating with rational numbers in different forms and for solving inequalities of the form p(x + q) ≥ r. This item requires an application of mathematics in a real-world scenario where students must interpret and reason about the context in order to determine which concepts are needed to solve. The calculator is provided as a tool, which, if used, lessens the procedural complexity of the item.

Answer Key:

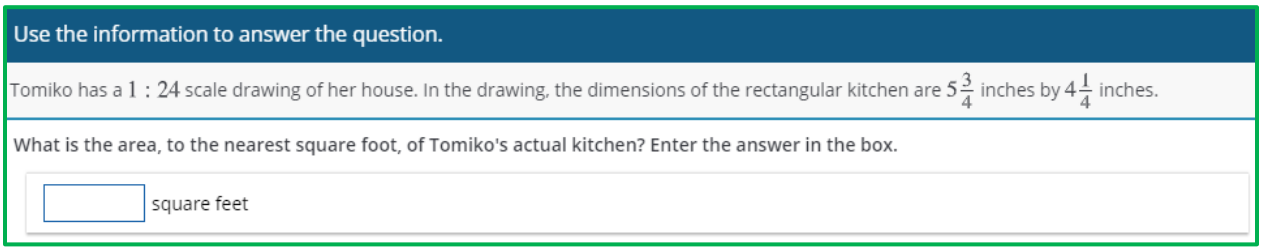
Use the information to answer the question.

Yuri is participating in a fund-raiser at school. She will receive donations from 2 people. A cousin will donate $\$0.40$ for every $\frac{1}{8}$ mile that Yuri walks. A friend will give Yuri a one-time donation of $\$30$.

What is the minimum number of miles Yuri needs to walk to raise at least $\$50$? Enter the answer in the box.

6.25 miles

Item 20
Domain: Geometry
7.G.A: Draw, construct, and describe geometrical figures and describe the relationships between them.
Calculator Availability: Yes



Alignment: 7.G.A.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Finding the area of the "real room" given scaled dimensions or an architectural plan is a common application of this grade 7 standard. Other examples of scale drawings include photocopies and maps. Students compute or estimate lengths for the real object by computing or measuring lengths from the drawing or description and multiplying by the scale factor. Students should ask questions like: What is the same and what is different about the scale drawings and their original counterparts? While the lengths are not the same, they differ by a constant scale factor. There are multiple paths to a solution in this item. Students could first determine the dimensions of the actual kitchen using the scale provided, and then use those to find the area. Or students may choose to find the area of the room on the drawing first, then apply the scale factor to find the area of the room. With either method, students will need to convert their measurement from square inches to square feet.

Coherence: In grade 3, students began developing the concept of area as tiling and learned that the measurement of rectangular regions is a multiplicative relationship of the number of square units in a row and the number rows.[3.MD.C] In grade 4, students found the area of rectangles using a formula.[4.MD.A.3] In grade 5, students developed the concept of volume and related it to multiplication and addition in order to solve problems involving volume of rectangular prisms.[5.MD.C.5] In grade 6, students tied together the work of decomposing figures and using additive properties to solve problems involving areas of polygons.[6.G.A.1] This work extends to grade 7, where students are applying their proportional reasoning skills[7.RP.A.2] to the concept of area and scale drawings of geometric figures.[7.G.A.1] In high school, students will extend their knowledge to solve more complex design problems.[HSG-MG.A.3]

Rigor: This item attends to conceptual understanding, procedural skill, and application. Students must understand the concept of a scale drawing. This item requires an application of mathematics in a real-world scenario where students must interpret and reason about the context and how to convert measurement units in order to solve. The procedures of multiplying fractions should be well-established, and the calculator is provided as a tool, which, if used, lessens the procedural complexity.

Answer Key:

Use the information to answer the question.

Tomiko has a $1 : 24$ scale drawing of her house. In the drawing, the dimensions of the rectangular kitchen are $5\frac{3}{4}$ inches by $4\frac{1}{4}$ inches.

What is the area, to the nearest square foot, of Tomiko's actual kitchen? Enter the answer in the box.

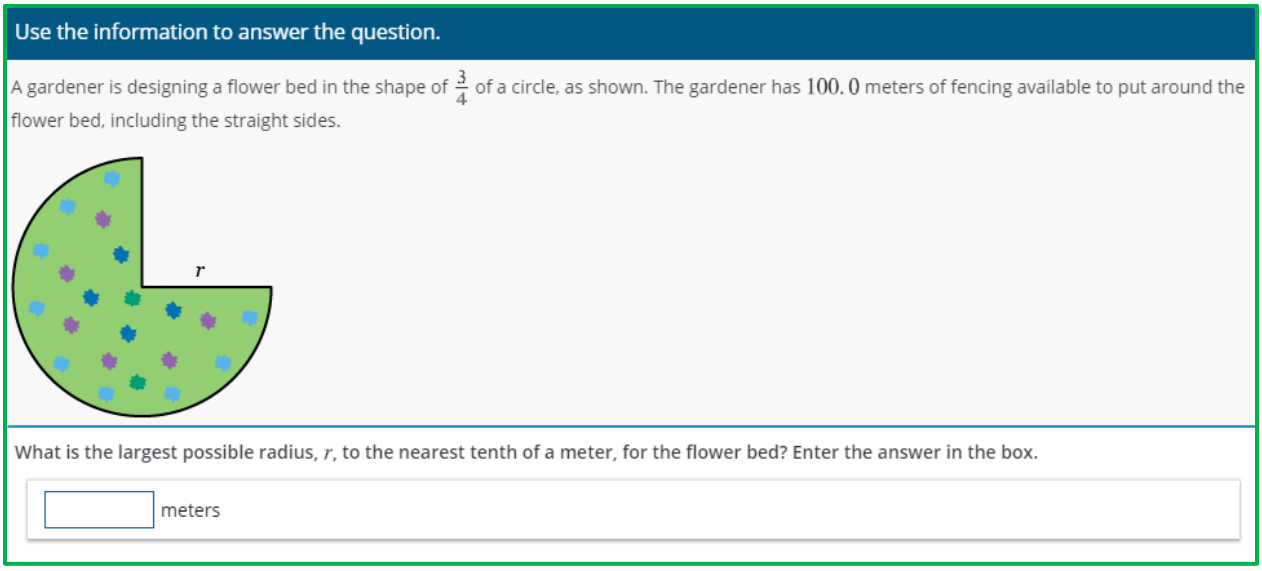
98 square feet

Item 21

Domain: Geometry

7.G.B: Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Calculator Availability: Yes



Alignment: 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.

This item requires students to understand both the meaning of circumference and the relationship between circumference and radius in order to find the maximum allowable radius given a constraint. Depending on which value of pi is used for calculations, students may calculate the maximum radius as 14.89 meters and then round up to 14.9, or may decide to round down to 14.8 because 100.0 meters of fencing could be insufficient. To account for this attention to precision, this item is keyed for both 14.8 meters and 14.9 meters.

Coherence: In grade 3, students began developing concepts of area and perimeter as attributes of plane figures.[3.MD.C/D] Students learned that the measurement of rectangular regions is a multiplicative relationship of the number of square units in a row and the number rows.[3.MD.C] In grade 4, students found the area of rectangles using a formula.[4.MD.A.3] In grade 5, students developed the concept of volume, and related it to multiplication and addition in order to solve problems involving volume of rectangular prisms.[5.MD.C.5] In grade 6, students tied together the work of decomposing figures and using additive properties to solve problems involving areas of polygons.[6.G.A.1] In grade 7, students connect the meaning of area and perimeter to a familiar shape with a curved boundary.[7.G.B.4] This work extends to grade 8, where students will find the volume of figures with circular bases,[8.G.C.9] and in high school where students will extend their knowledge to solve more complex design problems[HSG-MG.A.3] and problems involving arc lengths and sectors.[HSG-C.B.5]

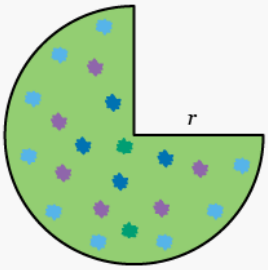
Rigor: This item attends to conceptual understanding, procedural skill, and application. Students use conceptual understanding as they interpret the context and decide to use the circumference formula in

the solution of the problem. The 3/4-circle elevates the conceptual complexity as it requires reasoning about how to calculate the circumference versus the simple procedure of substituting values into the circumference formula to calculate the radius. The mathematics is not directly indicated in the real-world scenario. Once a path forward is determined, students use the grade-level procedure of working with the circumference formula to find the correct answer.

Answer Key: There are multiple equivalent correct responses. One sample correct response is shown.

Use the information to answer the question.

A gardener is designing a flower bed in the shape of $\frac{3}{4}$ of a circle, as shown. The gardener has 100.0 meters of fencing available to put around the flower bed, including the straight sides.



What is the largest possible radius, r, to the nearest tenth of a meter, for the flower bed? Enter the answer in the box.

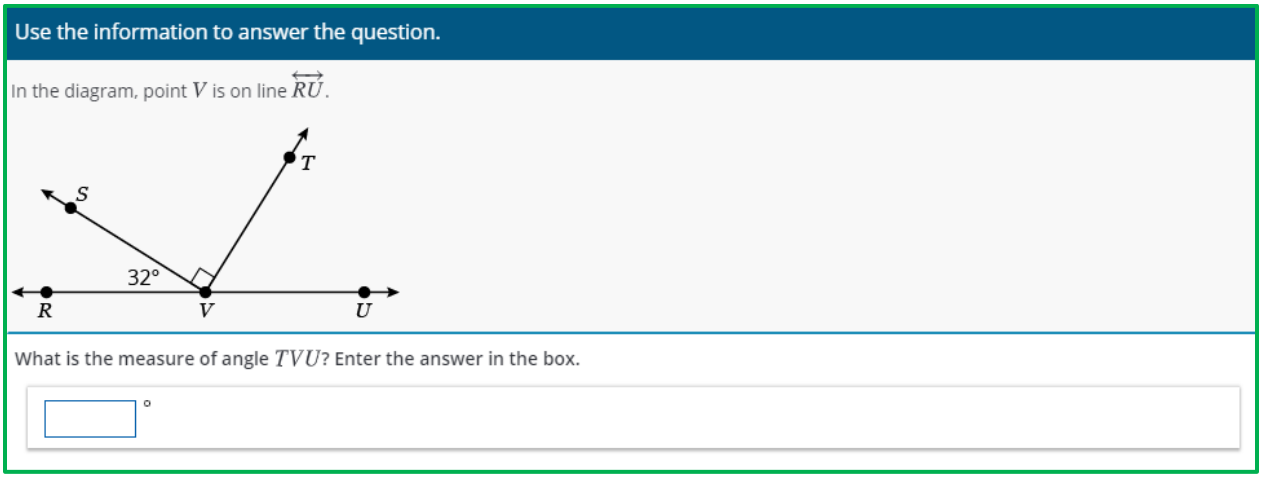
14.9 meters

Item 22

Domain: Geometry

7.G.B Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Calculator Availability: Yes



Alignment: 7.G.B.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.

This item asks students to solve for an unknown angle by synthesizing and applying knowledge of the properties of adjacent, supplementary, complementary, and right angles. There are multiple approaches to arrive at the measure of angle TVU. Knowledge of angle measurements allows students to use algebraic reasoning to determine an unknown value.

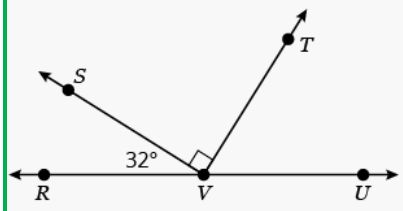
Coherence: Geometry has two important themes that began in elementary grades, one of which was the understanding of properties of geometric figures and the logical connections between them. In grade 4, students were introduced to the concept of an angle[4.G.A.1] and learned that angle measures are additive.[4.MD.C.7] In grade 6, students continued their geometry work with composition and decomposition of rectilinear figures. In grade 7, students use their knowledge of algebra and facts about angles to write and solve simple equations to find unknown angles in figures. This work extends to grade 8, where students will use informal arguments to establish facts about the angle sum and exterior angle of triangles and about the angles created when parallel lines are cut by a transversal.[8.G.A.5]

Rigor: This item attends to conceptual understanding and procedural skill. Students recall the definitions of complementary, supplementary, adjacent, and right angles to find the missing angle. They apply below grade level procedures of addition or subtraction to complete the computation, with a calculator provided as a tool.

Answer Key:

Use the information to answer the question.

In the diagram, point V is on line $\overleftrightarrow{RU}$.



What is the measure of angle TVU? Enter the answer in the box.

58 °

Item 23
Domain: Statistics and Probability
7.SP.A: Use random sampling to draw inferences about a population.
Calculator Availability: No

Use the information to answer the question.

Mrs. Jerome has a box that contains a large number of small blue beads and small green beads. All the beads are the same size and shape. Each of Mrs. Jerome's students selects a random sample of 50 beads and calculates the percentage of blue beads in the sample. The table shows the sample percentages calculated by four students.

Student	Sample Percentage of Blue Beads
Student 1	35%
Student 2	28%
Student 3	26%
Student 4	30%

Which statement best explains the differences in the sample percentages?

A. Three of the students had bad samples.
B. Sample percentages will differ between random samples.
C. Two of the students made errors calculating their percentages.
D. One of the students knew the true percentage of blue beads in the box.

Alignment: 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.

Developing an understanding of sampling to draw interferences about a population is an important foundation for work with statistics. Students realize that conclusions drawn from random samples generalize beyond the sample to the population from which the sample was selected, but a sample statistic is only an estimate of a corresponding population parameter and there will be some discrepancy between the two. Understanding the variability in sampling allows the investigator to gauge the expected size of that discrepancy. This item touches on the idea that variability exists in real life and is not necessarily a result of human error. The context of the item is simple and relatable to students which allows them to determine an explanation of why there is a difference in sample proportions.

Coherence: In grades 4 and 5, students extended their understanding of the number line to create line plots with whole numbers[4.MD.B.4] and fractions.[5.MD.B.2] In grade 6, students extended this knowledge to other representations including box-plots, histograms, and dot plots.[6.SP.B.5] Also in grade 6, students extended their knowledge of symmetric shapes to describe data displayed in dot plots and histograms and identified other attributes of displayed data such as clusters, peaks, and gaps.[6.SP.A.2] In grade 7, students begin to explore sampling and variation in sampling methods. A statistic computed from a random sample, such as the mean of the sample, can be used as an estimate of that same characteristic of the population from which the sample was selected. This estimate must be viewed

with some degree of caution because of the variability in both the population and sample data. A basic tenet of statistical reasoning, then, is that random sampling allows results from a sample to be generalized to a much larger body of data, namely, the population from which the sample was selected. This is foundational for the more advanced work in high school where students interpret, display, and solve problems with categorical and quantitative data[HSS-ID.A] and make inferences and justify conclusions about a population based on samples.[HSS-IC.A/B]

Rigor: This item attends to conceptual understanding and application. Students must understand the concept of sample proportions and know that they may be different even when the sample size and population are the same. This item requires an application of mathematics that is directly indicated in a real-world scenario.

Answer Key:

Use the information to answer the question.

Mrs. Jerome has a box that contains a large number of small blue beads and small green beads. All the beads are the same size and shape. Each of Mrs. Jerome's students selects a random sample of 50 beads and calculates the percentage of blue beads in the sample. The table shows the sample percentages calculated by four students.

Student	Sample Percentage of Blue Beads
Student 1	35%
Student 2	28%
Student 3	26%
Student 4	30%

Which statement best explains the differences in the sample percentages?

- A. Three of the students had bad samples.
- B. Sample percentages will differ between random samples.
- C. Two of the students made errors calculating their percentages.
- D. One of the students knew the true percentage of blue beads in the box.

Item 24
Domain: Statistics and Probability
7.SP.B: Draw informal comparative inferences about two populations.
Calculator Availability: Yes

Use the information to answer the question.

Over the course of a year, the daily high temperatures are recorded for two cities. The data for each city is summarized in the table.

	Daily High Temperatures in Riverside (°F)	Daily High Temperatures in Springfield (°F)
Maximum	99	78
Upper Quartile	88	71
Median	80	63
Lower Quartile	52	44
Minimum	43	37

Based on the information in the table, which statement about the data for the two cities is true?

A. All the daily high temperatures for Riverside exceed all the daily high temperatures for Springfield.

B. At least half the daily high temperatures for Riverside exceed the maximum daily high temperature for Springfield.

C. There is less variability in the daily high temperatures for Riverside than in the daily high temperatures for Springfield.

D. The range of the daily high temperatures for Riverside is equal to the range of the daily high temperatures for Springfield.

Alignment: 7.SP.B.4: Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.

Interpretation of data displays is an important life skill. This application item asks students to use measures of center and variability from data in a table to draw inferences about the high temperature in two cities. Students must understand the concept of median and interquartile range and how those measures for one data set relate to the measures of another data set. This type of problem goes beyond simple identification of values for data sets and asks students to reason and make connections resulting in a conclusion about the data sets.

Coherence: In grade 6, students were asked to calculate mean, median, and interquartile range, and describe any overall pattern as well as any striking deviations from the overall pattern with reference to the context in which the data was gathered.[6.SP.B.5c/d] In grade 7, students explore comparative inferences about *two* populations. This is foundational for the more advanced work in high school when students will interpret, display, and solve problems with categorical and quantitative data[HSS-ID.A] and make inferences and justify conclusions about a population based on samples.[HSS-IC.A/B]

Rigor: This item attends to conceptual understanding and application. Students must understand the concepts of median, variation, and range. This item requires an application of mathematics that is directly indicated in a real-world scenario.

Answer Key:

Use the information to answer the question.

Over the course of a year, the daily high temperatures are recorded for two cities. The data for each city is summarized in the table.

	Daily High Temperatures in Riverside (°F)	Daily High Temperatures in Springfield (°F)
Maximum	99	78
Upper Quartile	88	71
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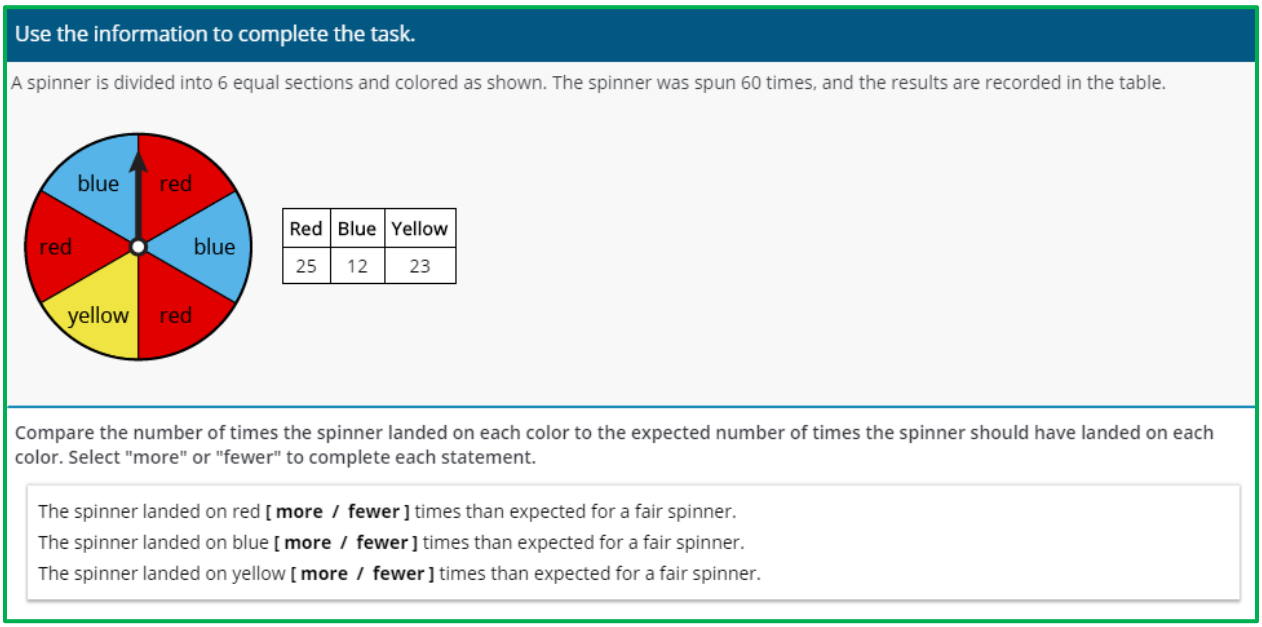
Lower Quartile	52	44
Minimum	43	37

Based on the information in the table, which statement about the data for the two cities is true?

- A. All the daily high temperatures for Riverside exceed all the daily high temperatures for Springfield.
- B. At least half the daily high temperatures for Riverside exceed the maximum daily high temperature for Springfield.
- C. There is less variability in the daily high temperatures for Riverside than in the daily high temperatures for Springfield.
- D. The range of the daily high temperatures for Riverside is equal to the range of the daily high temperatures for Springfield.

Item 25
Domain: Statistics and Probability
7.SP.C: Investigate chance processes and develop, use, and evaluate probability models.
Calculator Availability: Yes



Alignment: 7.SP.C.7: 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 *probability* model provides a probability for each possible nonoverlapping outcome for a chance process such that the total probability over all such outcomes is unity. The probabilities of the model can be either *theoretical* (based on the structure of the process and its outcomes) or *empirical* (based on observed data generated by the process). This item assesses the part of the standard of comparing probabilities from a model to observed frequencies by asking students to compare the probability based on experimental results with the theoretical probability of the events. This item requires students to make multiple comparisons between probabilities of events using simple numbers.

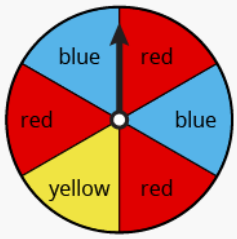
Coherence: This standard brings together the grade level expectation of using proportional relationships[7.RP.A.3] with determining probability of a chance event.[7.SP.C.6] This connection is foundational for more advanced work in high school when students will explore rules of probability, including those for conditional and compound probabilities.[HSS-CP.A/B]

Rigor: This item attends to conceptual understanding and application. Students must understand how to use the spinner to define the expected probability and engage in a simple comparison to the actual results of spinning. This item requires an application of mathematics that is directly indicated in a familiar real-world scenario.

Answer Key:

Use the information to complete the task.

A spinner is divided into 6 equal sections and colored as shown. The spinner was spun 60 times, and the results are recorded in the table.



Red	Blue	Yellow
25	12	23

Compare the number of times the spinner landed on each color to the expected number of times the spinner should have landed on each color. Select "more" or "fewer" to complete each statement.

The spinner landed on red [**more** / **fewer**] times than expected for a fair spinner.
The spinner landed on blue [**more** / **fewer**] times than expected for a fair spinner.
The spinner landed on yellow [**more** / **fewer**] times than expected for a fair spinner.

Appendix

NWEA and MAP Growth Math

NWEA is a research-based, not-for-profit organization that supports students and educators worldwide. For forty years, NWEA has developed assessments and professional learning offerings to help advance all students along their optimal learning paths.

This document presents a collection of assessment items representative of those that students would see on NWEA MAP Growth Math assessments. NWEA MAP Growth Math assessments reveal how much growth has occurred between testing events and, when combined with our norms, show projected proficiency. Educators can track growth through the school year and over multiple years.

College- and Career-Readiness Shifts in Mathematics

Over the past decade, states have adopted CCR mathematics standards that emphasize focus, coherence, and rigor, which are now reflected in instructional materials, classroom practice, and assessment. CCR standards contribute to transformative changes in the classroom and better prepare students for opportunities following high school.

Focus

The Common Core and other CCR standards call for a sharper focus in mathematics. Rather than racing to cover topics in a mile-wide, inch-deep curriculum, CCR standards require teachers to significantly narrow and deepen the ways instructional time and energy are spent in the math classroom.

Teachers should spend most of their instructional time on the key knowledge and understandings of the grade. The remaining standards within a grade will support and engage students in the major work of the grade. Some organizations, like Student Achievement Partners, recommend that at least 65%—and up to approximately 85%—of class time should be devoted to those areas.

Table 1 shows the key knowledge and understandings of grades K–8, adapted from Student Achievement Partner's *Highlights of Major Work in Grades K–8*. Table 2 shows the major work of grades K–8, which is adapted from Student Achievement Partner's *Focus by Grade Level.*

Table 1: Key Knowledge and Understandings of Grades K–8

Grade	Key Knowledge and Understandings
K	Counting and number sense; understanding the meaning of addition and subtraction; and introduction to place value
1	Concepts and strategies for addition and subtraction; whole numbers and place value; and understanding and measuring length
2	Place value; addition and subtraction; problem solving with addition and subtraction; and measurement with standard units
3	Multiplication and division of whole numbers; fraction concepts; problem solving; and area concepts
4	Place value; fluency with addition and subtraction; fraction equivalence and ordering; operations with fractions; decimal notation for fractions; and problem solving
5	Decimal place value and operations; fluency with whole-number and decimal operations; addition and subtraction of fractions with unlike denominators; multiplication of fractions and division involving whole numbers and unit fractions; and volume
6	Ratios and proportional reasoning; expressions and equations; division of fractions; and the extension to the rational number system
7	Ratios and proportional relationships; expressions and equations; and arithmetic of rational numbers
8	Linear equations; concept of functions; congruence and similarity in terms of transformations; and the Pythagorean Theorem

Table 2: Major Work, K–8

K	1	2	3	4	5	6	7	8
Counting and Cardinality • Know number names and the count sequence. • Count to tell the number of objects. • Compare numbers.								
Operations and Algebraic Thinking • Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.	**Operations and Algebraic Thinking** • Represent and solve problems involving addition and subtraction. • Understand and apply properties of operations and the relationship between addition and subtraction. • Add and subtract within 20. • Work with addition and subtraction equations.	**Operations and Algebraic Thinking** • Represent and solve problems involving addition and subtraction. • Add and subtract within 20.	**Operations and Algebraic Thinking** • Represent and solve problems involving multiplication and division. • Understand properties of multiplication and the relationship between multiplication and division. • Multiply and divide within 100. • Solve problems involving the four operations, and identify and explain patterns in arithmetic.	**Operations and Algebraic Thinking** • Use the four operations with whole numbers to solve problems.		**Expressions and Equations** • Apply and extend previous understandings of arithmetic to algebraic expressions. • Reason about and solve one-variable equations and inequalities. • Represent and analyze quantitative relationships between dependent and independent variables.	**Expressions and Equations** • Use properties of operations to generate equivalent expressions. • Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	**Expressions and Equations** • Work with radicals and integer exponents. • Understand the connections between proportional relationships, lines, and linear equations. • Analyze and solve linear equations and pairs of simultaneous linear equations.
Number and Operations in Base Ten • Work with numbers 11–19 to gain foundations for place value.	**Number and Operations in Base Ten** • Extend the counting sequence. • Understand place value. • Use place value understanding and properties of operations to add and subtract.	**Number and Operations in Base Ten** • Understand place value. • Use place value understanding and properties of operations to add and subtract.		**Number and Operations in Base Ten** • Generalize place value understanding for multi-digit whole numbers. • Use place value understanding and properties of operations to perform multi-digit arithmetic.	**Number and Operations in Base Ten** • Understand the place value system. • Perform operations with multi-digit whole numbers and with decimals to hundredths.	**The Number System** • Apply and extend previous understandings of multiplication and division to divide fractions by fractions. • Apply and extend previous understandings of numbers to the system of rational numbers.	**The Number System** • Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	

	Measurement and Data • Measure lengths indirectly and by iterating length units.	**Measurement and Data** • Measure and estimate lengths in standard units. • Relate addition and subtraction to length.	**Measurement and Data** • Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects. • Geometric measurement: understand concepts of area and relate area to multiplication and to addition.		**Measurement and Data** • Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.			**Geometry** • Understand congruence and similarity using physical models, transparencies, or geometry software. • Understand and apply the Pythagorean Theorem.
			Number and Operations—Fractions • Develop understanding of fractions as numbers.	**Number and Operations—Fractions** • Extend understanding of fraction equivalence and ordering. • Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers. • Understand decimal notation for fractions, and compare decimal fractions.	**Number and Operations—Fractions** • Use equivalent fractions as a strategy to add and subtract fractions. • Apply and extend previous understandings of multiplication and division to multiply and divide fractions.			
						Ratios and Proportional Relationships • Understand ratio concepts and use ratio reasoning to solve problems.	**Ratios and Proportional Relationships** • Analyze proportional relationships and use them to solve real-world and mathematical problems.	**Functions** • Define, evaluate, and compare functions. • Use functions to model relationships between quantities.
Adapted from Student Achievement Partners, https://achievethecore.org/category/774/mathematics-focus-by-grade-level								

Coherence

CCR standards progress coherently from grade to grade and link to major topics within grades.

- **Thinking across Grades:** CCR standards are designed around coherent progressions from grade to grade. Learning is carefully connected across grades so that students can build new understanding on foundations constructed in previous years. Each standard is part of a larger story; no standard is isolated.
- **Linking to Key Areas of Focus:** Instead of allowing supportive topics to detract from the focus of the grade, these concepts serve the grade-level key areas of focus. For example, instead of data displays being an end in themselves, they are an opportunity to do grade-level computation in an application setting.

See Achieve the Core's Coherence Map for an interactive tool that shows progressions within the Common Core State Standards for Mathematics.

Rigor

CCR standards, especially in major topics, pursue conceptual understanding, procedural skill and fluency, and application with equal intensity.

- **Conceptual Understanding:** CCR standards call for conceptual understanding of key concepts such as place value and operations. Students must be able to access concepts from a variety of perspectives to enable the students to see mathematics as more than a set of mnemonics or discrete and disconnected procedures.
- **Procedural Skill and Fluency:** CCR standards call for flexibility, efficiency, and accuracy in calculation. Students learn core procedures, such as multidigit multiplication, in order to have access to more complex concepts and procedures.
- **Application:** CCR standards call for students to use mathematics flexibly for applications in problem-solving contexts.

Equity and Accessibility Considerations

A major component of equity in assessment and instruction is accessibility. A primary goal of NWEA is to develop assessments that are fair and equitable to all students. We write every item to be accessible with well-aligned content and grade-appropriate contexts that are familiar or understandable by all students.

NWEA uses multiple readability measures to ensure grade-appropriate vocabulary. NWEA encourages teachers to use the vocabulary found in grade-level standards with their students in the classroom. The kindergarten and grade 1 item sets show audio icons with each item. This signals that NWEA products offer appropriate audio support to students at these lower grades. Students can replay audio for individual parts of items designed for these grade levels.

Item Functionality and Scoring

Item Types

The following item types are used in this item set:

- **Choice:** Students select one out of four or five options.
- **Choice Multiple:** Students select two or more options out of five to eight total options.
- **Drag and Drop:** Students move digits or objects into onscreen containers. Examples include filling in data in a graph or placing a number on a number line.
- **Text Entry:** Students use the keyboard to type in a numerical response.
- **Hot Text:** Students select text to indicate their response.

Scoring

Each item shows one correct response; however, some items may have multiple equivalent correct responses. For example, text entry items may have mathematically equivalent correct responses such as "31.1," "031.1," and "31.10." Similarly, drag-and-drop items may require students to create a fraction or expression, and equivalent fractions or expressions are counted and keyed appropriately.

Calculators

For the MAP Growth Math assessment, calculators are not provided for items assessing K–5 standards. Items assessing standards for grade 6 and above have an appropriate calculator available to students when the calculator tool can assist in the required calculation and the calculation is not the skill being assessed. For example, a geometry item that requires students to determine the circumference of a circle would include a scientific calculator because the item is assessing students' knowledge of circles and related formulas, not multiplication skills, and the scientific calculator allows students to square values and provides values of π.

References

1. College- and Career-Ready Shifts in Mathematics, Achievethecore.org
2. CCSSO Criteria for High Quality Assessments, CCSSO.org
3. Coherence Map, Achievethecore.org
4. Mathematics Glossary, Table 1, Corestandards.org