GRADE 7 MATH: RATIONAL NUMBERS

UNIT OVERVIEW

This packet contains a curriculum-embedded, Common Core–aligned task and instructional supports. The task is embedded in a 3-week unit on the number system. This unit builds on previous 6th-grade units on rational numbers: ordering rational numbers and placing them on a number line, understanding absolute value, and representing quantities in real-world contexts. The unit provides students with the opportunity to deepen their understanding of rational numbers in various forms. Furthermore, this unit allows students to add, subtract, multiply, and divide rational numbers in various forms. The unit following this topic should focus on strategically applying properties of operations to add and subtract expressions with rational coefficients.

TASK DETAILS

Task Name: Rational Numbers

Grade: 7

Subject: Math

Depth of Knowledge: 3

Task Description: In this this task students will have to determine which of two businesses is making a profit by calculating the costs of supplies and wages as well as the profit. The costs and profit require calculations of rational numbers that include negative and positive numbers, fractions, and decimals.

Standards:

7.NS.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.

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

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

Standards for Mathematical Practice:

MP.1 Make sense of problems and persevere in solving them.
MP.2 Reason abstractly and quantitatively.
MP.3 Construct viable arguments and critique the reasoning of others.
MP.6 Attend to precision.

TABLE OF CONTENTS

The task and instructional supports in the following pages are designed to help educators understand and implement Common Core–aligned tasks that are embedded in a unit of instruction. We have learned through our pilot work that focusing instruction on units anchored in rigorous Common Core–aligned assessments drives significant shifts in curriculum and pedagogy. Callout boxes and Universal Design for Learning (UDL) supports are included to provide ideas around how to include multiple entry points for diverse learners.

GRADE 7 MATH: RATIONAL NUMBERS

PERFORMANCE TASK

Pizzeria Profits!

There are two businesses that have opened in Corona. Let's compare them and see which business makes a greater profit.

For the purpose of this project a month always has four weeks.

Frank's Pizzeria	Kelly's Pizzeria
Amount Spent on Supplies: $759.67 per week	Amount Spent on Supplies: $840.65 per week
Amount Spent Paying Employees: $2300.50 per month	Amount Spent Paying Employees: Once supplies are paid for, Kelly's Pizzeria pays employees 7/8 of the amount earned for the month.
Amount Earned Selling Pizza: Week 1: $1500 Week 2: $1200 Week 3: $800 Week 4: $1420	Amount Earned Selling Pizza: Week 1: $1740.25 Week 2: $1490.17 Week 3: $2807.13 Week 4: $650.35

Use the information from above to answer the following questions. Show your work in the space below each question.

a) How much money do the employees from Frank's Pizzeria earn per week? How much money do the employees from Kelly's Pizzeria earn by the end of the month?

Frank's Pizzeria	Kelly's Pizzeria

b) By the end of the fourth week there was either a net loss or net gain for each business. Determine the net loss or gain for each business that occurred by the end of the fourth week. Which business had a net loss? Justify your response.
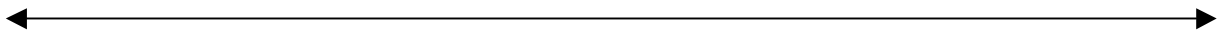
Frank's Pizzeria	Kelly's Pizzeria

_____

_____

_____

c) Use your response from Question B to answer this question. How much more money should the business(es) have made in order to break even? Show your work.

_____

_____

_____

d) Frank's Pizzeria has a champion pizza eater named Sandy who can eat 6½ slices in 2 minutes. Kelly's Pizzeria has a champion pizza eater named James who can eat 3 slices in 1½ minutes. Who can eat more pizza in 1 minute?

Frank's Pizzeria	Kelly's Pizzeria

Use a number line to show the difference between the amounts of pizza eaten by the two competitors in one minute.

e) What fraction of the total sales for four weeks is used to pay for supplies for each business? Write this amount also in decimal and percent form.

Frank's Pizzeria	Kelly's Pizzeria

f) Amanda would like to own Frank's Pizzeria. If Amanda only purchases businesses that earn a profit, would you agree or disagree with her decision? Explain your reasoning and include details of the business' net gain or loss to support your response.

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_____

GRADE 7 MATH: RATIONAL NUMBERS

RUBRIC

The following rubric is intended to be used to asses students' knowledge and performance on the targeted Common Core standards and Mathematical Practice standards for the unit.

Three-Point Score

The response accomplishes the prompted purposes and effectively communicates the student's understanding. The student's strategy and execution meet the content (including concepts, technical representations, and connections), thinking processes, and qualitative demands of all parts of the task. Omissions may exist, but do not detract from the correctness of the response. Minor arithmetic errors may be present, but no errors of reasoning appear.

Make sense of problems and persevere in solving them: Work includes representations of the problem indicating the student made sense of the problem and advanced toward a correct solution.	
Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Reason abstractly and quantitatively: Correctly abstracts information from the word problem to create a mathematical representation of the problem. Correctly applies properties of operations as strategies to add, subtract, multiply, and divide rational numbers. Understands that subtraction of rational numbers is adding the additive inverse. Understands that spending on supplies and paying employees is a negative amount. Solves the problem correctly and notes the meaning of the results in the context of the problem. **Construct viable arguments and critique the reasoning of others:** Justifies the answer to Part F using appropriate mathematical reasoning from Part E. Response indicates the ability to apply properties of operations with rational numbers. **Attend to precision:** Correctly adds, subtracts, and multiplies the rational numbers. Computes the fraction of the total cost used for supplies for both pizzerias and writes it in percent form.	Response indicates the ability to apply properties of operations as strategies to add, subtract, and multiply and divide rational numbers. A. Correctly computes what Frank's Pizzeria pays their employees per week by dividing $2300.50 by 4 to get $575.13. Correctly computes that Kelly's Pizzeria pays its employees $2909.64 after the end of the fourth week by multiplying 7/8 by $3325.30, which is the profit made after paying the supplies. B. Correctly abstracts information from the problem and writes the amount for spending on supplies and paying employees as a negative amount. Correctly calculates that Frank's Pizzeria has a net loss of $419.18 and Kelly's Pizzeria has a net gain of $415.66. C. Understands that opposite quantities combine to make 0. Determines the net loss for Frank's Pizzeria after four weeks is $418.68. Shows that in order to "break even" after the four weeks, Frank's Pizzeria must have made $418.68 more. D. Correctly abstracts information from the problem to create a proportion, or divides the fraction by a whole number and determines the unit rate for both competitors. Correctly calculates Sandy eats 3¼ slices in 1 minute AND James eats 2 slices in 1 minute. Correctly constructs a number line and labels the rational numbers to show subtraction of 3¼ – 2 slices to get 1¼.

| | E. Shows the ability to write mathematical information in fraction form and percent form. Response indicates the ability to understand that Kelly's Pizzeria would be a better business to run because 50% of its total profit is for supplies, while Frank's Pizzeria uses 62% of its total profit for supplies. |
| | F. Understands the real-life connection of net loss and gain in businesses in order to make a profit. Disagrees with Amanda's decision and states that although Kelly's Pizzeria spent more on supplies and paying its employees, its total profit after the four weeks was higher. |

Two-Point Score

The response accomplishes the prompted purposes and effectively communicates the student's mathematical understanding. The student's strategy and execution meet the content (including concepts, technical representations, and connections), thinking processes, and qualitative demands of all parts of the task. Some necessary connections between the context and the operations with rational numbers may be missing.

Make sense of problems and persevere in solving them:
Work includes representations of the problem indicating the student made sense of the problem and advanced towards a correct solution, but indicates struggle to interpret parts of the context correctly.

Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Reason abstractly and quantitatively: Correctly abstracts information from the word problem to create mathematical representation of the problem. Correctly applies properties of operations as strategies to add, subtract, or multiply rational numbers. Fails to understand that subtraction of rational numbers is adding the additive inverse. Understands that spending on supplies and paying employees is a negative amount. Solves the problem correctly, but struggles to interpret the meaning of the results in the context of the	Response indicates the ability to apply properties of operations as strategies to add, subtract, and multiply the rational numbers, but fails to interpret the meaning of the results in the context of the problem. A. Correctly computes the amount paid for employees for Frank OR Kelly's Pizzeria. B. Correctly computes the net loss or gain after the four weeks for Frank OR Kelly's Pizzeria. Understands that spending on supplies and paying employees' salary is a negative amount. C. Fails to understand that opposite quantities combine to make 0. Is not able to determine the net loss for Frank's Pizzeria in four weeks is $418.68 and that Frank should have made an additional $418.68 to "break even." D. Is able to find the unit rate for the Sandy OR

	James. Correctly constructs the number line, but does not use it to show subtraction of rational numbers.
problem. **Construct viable arguments and critique the reasoning of others:** Fails to justify the answer to Part F using appropriate mathematical reasoning from Part E. Response indicates the ability to apply properties of operations with rational numbers, but struggles to understand the meaning of the results. **Attend to precision:** Correctly adds, subtracts, and multiplies the rational numbers for Frank's Pizzeria OR Kelly's Pizzeria. Computes the fraction of the total cost used for supplies for both pizzerias and writes it in fraction OR percent form.	E. Shows the ability to write mathematical information in fraction form OR percent form. F. Response indicates struggle to interpret that Kelly's Pizzeria would be a better business to run. Fails to answer Part D using evidence from Part C and states Kelly's Pizzeria would not profit after four weeks because it spent more on supplies and paying its employees.

One-Point Score

The response accomplishes some of the prompted purposes and communicates the student's mathematical understanding. The student's strategy and execution meet only a few of the content demands of the task. The necessary connections between the operations with rational numbers and the context are missing.

Makes sense of problems and persevere in solving them: Work is missing representations of the problem or understanding of the constraints of the problem given in the context.	
Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Reason abstractly and quantitatively: Correctly abstracts information from the word problem, but fails to create mathematical representation of the problem. Correctly applies properties of operations as strategies to add, subtract, and multiply rational numbers. Fails to understand that subtraction of rational numbers is adding the additive inverse. Understands that spending on supplies and paying employees is a negative amount. Solves the	A. Correctly computes the amount paid for employees for Frank OR Kelly's Pizzeria. B. Does not understand that spending on supplies and paying employees' salary is a negative amount. Correctly adds the rational numbers for the four weeks to find the profit. C. Fails to understand that opposite quantities combine to make 0. Is not able to determine the net loss for Frank's Pizzeria in four weeks is $418.68. D. Correctly writes the fraction of the cost spent on supplies, but may not write it in percent form. E. May not explain which business he/she would prefer to run and fails to support response with

problem correctly, but struggles to interpret the meaning of the results in the context of the problem. **Construct viable arguments and critique the reasoning of others:** Response to Part F does not indicate the ability to use mathematical information to support an argument and understand the meaning of the results. **Attend to precision:** Correctly adds and subtracts rational numbers to find the net loss on supplies after three weeks, but fails to determine the net loss of paying the employees for three weeks for Frank OR Kelly's Pizzeria. Computes the fraction of the total cost used for supplies for both pizzerias and writes it in fraction OR percent form.	mathematical information.

GRADE 7 MATH: RATIONAL NUMBERS

INSTRUCTIONAL SUPPORTS

The instructional supports on the following pages include a unit outline with formative assessments and suggested learning activities. Teachers may use this unit outline as it is described, integrate parts of it into a currently existing curriculum unit, or use it as a model or checklist for a currently existing unit on a different topic.

Department of
Education
Dennis M. Walcott, Chancellor

Unit Outline

Grade 7 Math: Rational Numbers

UNIT TOPIC AND LENGTH:

➢ The sequence of related lessons is intended to take 10–12 instruction periods (90 minutes), depending on students' prior knowledge of operating with fractions, decimals, and percents. It is recommended that this unit be taught as the first unit since most of the latter topics require a deep understanding of rational numbers.

COMMON CORE LEARNING STANDARDS:

➢ 7.NS.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.
➢ 7.NS.2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
➢ 7.NS.3. Solve real-world and mathematical problems involving the four operations with rational numbers.

STANDARDS FOR MATHEMATICAL PRACTICE:

MP.1. Make sense of problems and persevere in solving them.
MP.2. Reason abstractly and quantitatively.
MP.3. Construct viable arguments and critique the reasoning of others.
MP.6. Attend to precision.

BIG IDEAS/ENDURING UNDERSTANDINGS:	**ESSENTIAL QUESTIONS:**
➢ Subtraction of rational numbers is adding the additive inverse.	➢ How can mathematical operations with rational numbers help us make real-life decisions?
➢ When adding two rational numbers $p + q$ as the number located a distance $|q|$ from p in the positive or negative direction, depending on where q is positive or negative.	➢ How can adding two rational numbers with opposite quantities make zero?
➢ Multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers.	
➢ Integers can be divided, provided that the divisor is not zero and every quotient of integers is a rational number.	
➢ Solve real-world mathematical problems involving the four operations with rational numbers.	

CONTENT:	SKILLS:
➢ Students will apply properties of operations as strategies to add, subtract, multiply, and divide rational numbers.	➢ Skills are represented in the standards.

VOCABULARY/KEY TERMS:

opposite, additive inverse, absolute value, integer, divisor, rational number

ASSESSMENT EVIDENCE AND ACTIVITIES:

INITIAL ASSESSMENT: RATIONAL NUMBERS INITIAL TASK
The initial assessment of the unit asks students to:
a) Use order of operations to add two positive mixed numbers to a negative mixed number, then critique the reasoning of another that identified a property and justify with an explanation.
b) Explain why dividing two negative rational numbers gives a positive response by applying a formula or using prior knowledge of proportional reasoning.
c) Using knowledge of rational numbers as a percent to operate two rational numbers from a real-life situation.

FORMATIVE ASSESSMENTS:

ELECTRONS AND PROTONS TASK
a) Students will find the total charge of ions that have positive and negative charges. A mathematical sentence or equation should be provided with an explanation. Work should be shown.
b) Demonstrate how to take the sum of positive and negative anions by using a number line.
c) Find the difference between two different total anion charges. Work should be shown.

RATIONAL NUMBERS GAME
a) Students will identify a winner by taking the sum of several positive and negative rational number scores and explain how estimation or mental math could have helped.
b) Find the missing rational number that when added to the final scores would give a total score of 30 points.

FINAL PERFORMANCE TASK:

The final performance task of the unit is titled "Rational Numbers Task". The task asks students to:
a) Calculate employee salary for two businesses by dividing and multiplying rational numbers that include negative decimals and fractions.
b) Determine the net loss and/or gain for each company by adding the profit and subtracting the supplies and salary. One business ends with a net loss and one with a net gain. Each response requires addition and subtraction of rational numbers that include positive and negative numbers with fractions, whole numbers, and decimals.
c) Calculate the opposite of –419.18, the answer from a previous question, by knowing that a number and its opposite equal zero.
d) Use the number line to calculate the difference between the amounts of pizza eaten by Frank's Pizzeria and the amounts eaten by Kelly's Pizzeria. Division must also be used to calculate the amount of pizza eaten in one minute by each competitor.

e) Determine the fraction of a cost and express the answer as a decimal and a percent.
f) Critique the reasoning of others by critiquing Amanda's choice of a company. This response requires an argument to justify which business is a better deal.

➢ This unit contains a pre-assessment and a post-assessment that contain multiple choice and extended response questions in addition to the final performance task. This pre- and post-assessment will be used to show progress within the unit from pre- to post-assessment. The pre-assessment will also be used to group students by ability in order to differentiate instruction.

➢ Throughout the unit there will be checkpoints. Checkpoints are quick assessments based on the unit standards. Students' solutions are then assessed and their progress is recorded.

➢ Teacher as facilitator: Teacher will facilitate class discussions that will clarify any misconceptions and help students gain deeper understanding of the concepts.

➢ Reflections: Students will reflect daily by writing in their sourcebook, a notebook kept in class for this purpose. This reflection may include, but is not limited to, summarizing the day's lesson, describing misconceptions classmates might have had, or simply answering a constructed response question.

➢ Conferencing: Teachers will conference with students either one-on-one or in a small group to make students aware of their progress in reference to their goals. Teachers should track students' progress in order to find similarities with other students and possibly group students by weakness.

Map and Guidance:

Day	Standards	Goal	Activity
1		To check students' prior knowledge of rational numbers.	Initial task
2		To have students describe real-life situations where opposite quantities can combine to make zero.	
3		To have students add rational numbers using a vertical and horizontal number line and apply this to real-life situations.	
4		To have students add integers using color counter chips.	(Lesson guidance below)
5		To have students subtract rational numbers using a vertical and horizontal number line and apply to real-life situations.	

6		To have students add and subtract rational numbers involving real-life problems.	(Lesson guidance below)	
6		To assess students in fluency when adding and subtracting rational numbers with and without a number line.	Formative assessments	
8		To have students investigate rules for multiplying rational numbers by following a pattern.	Multiplying rational numbers using a pattern (lesson guidance below)	
9		To have students apply knowledge from previous lesson to multiply rational numbers in real-life situations.		
10		To have students investigate rules for dividing rational numbers by following a pattern.		
11		To have students apply knowledge from previous lesson to multiply rational numbers in real-life situations.		
12		To assess students on the unit.	Final performance task	

Lesson Guidance (Day 4):

Common Core Standards: 7.NS.1.a, 7.NS.1.b
Agenda: How do we add integers using color counter chips?

Objective:
Students will be able to add integers using the number line and describe situations in which opposite quantities combine to make zero.

Warm-Up: Lesson on absolute value should be covered prior to this lesson.	
5 Minutes	Amy noted that the absolute value of 5 and –5 is the same. Do you agree or disagree? Justify your reasoning by finding the absolute value and explaining what it means. Answer: Yes, Amy is correct. The absolute value of 5 and –5 is 5. This indicates that both of these numbers are the same distance (5 units) from zero.

Vocabulary
integer, opposite, positive, negative, zero pair

Mini-Lesson 20

Introduce students to the concept of integers by providing a real-life situation:
What type of a number is it when you gain money? *Positive*
What type of a number is it when you owe someone money? *Negative*
Give a situation: If I have 4 dollars but owe my friend 1 dollar, how much do I have left?
Give another situation: If I have 3 dollars but owe my friend 5 dollars, how much do I have left?
**Misconception: Many students will respond with 2 dollars, not thinking about negative amounts.**

Introduce the color counter chips to let students know they can add integers using these chips.
Yellow chips are positive one and red chips are negative one.
Give the situation: If I have one dollar and owe my friend one dollar, how much do I have? *Zero* (This should help students understand that a yellow and a red chip together are called a "zero pair".
Example 1: Add $2 + -3$
Represent using the chips: →
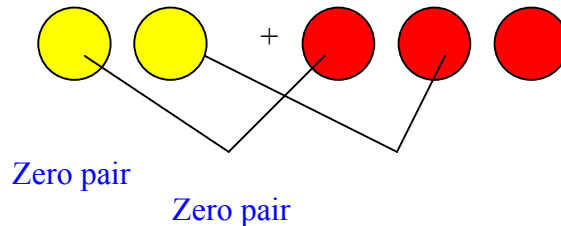
Zero pair
Zero pair

Step 1: Match one yellow and one red to cancel all the zero pairs.
Step 2: The remaining chip/s is the sum. $= -1$

Model two more examples: $-2 + -3$ and $-2 + 3$

Applied Practice

Activity One: Students can make adding integers with the number chips into a game.

Have students work in groups with a deck of 52 cards.
Rules: All the black cards are positive number and all the red cards are negative numbers.
Ace = 1, Jack = 11, Queen = 12, and King = 13
The teacher will provide students with a goal number, i.e., 20. The student who reaches the goal number first wins the game.
Students take turns picking a card from the deck face down. Once a student has picked his/her second card, he/she must write down the two integers on his/her paper and then use the chips to find the sum. This will ensure students show their work. Each round starts all over again until one of the players gets a score of 20 (or any other goal number). For higher-level students, the teacher can have the students find the sum of all the integers from five rounds (or more) to determine their final score.

Activity Two: Have students create their own two integers to add and show the work. Students can also draw the chips on their paper and use colored pencils.

Misconceptions: Students may have difficulty remembering which color represents which type of number. Students may struggle with adding more then two integers in one problem.

Lesson Guidance (Day 6)

Common Core Standards: 7.NS.1.a, 7.NS.1.b, 7.NS.c, 7.NS.d
Agenda: How do we add and subtract rational numbers involving real-life problems?

Objective:
Students will be able to add and subtract integers in word problems using rules.

Warm-Up: Lesson on adding and subtracting rational numbers with rules should be covered prior to this lesson.	
5 Minutes	Ex 1: –13 + –5 = Ex. 2: –13 – 5 = What do you notice about your answers to both examples? Explain. Same answer: –18, because subtracting a number is adding its opposite.

Vocabulary: Review key words that indicate which operation to use.
integer, positive, negative, zero pair

Mini-Lesson 20

Ask students when they see integers in real life.
Possible answers: temperature, elevation, stock market

Have students write the key word and the operation it represents. Students should also justify their response. **Students should be able to understand the number line and how the numbers are ordered. Positive numbers are greater than negative numbers. Negative numbers closer to zero are greater.**

Example 1: Altair has a negative balance of $10 in his bank account. If he deposits $45 into his account, how much money does Altair have in his account after the deposit?
Answer: Deposit: Add money: –$10 + $45 = $35

Example 2: In Buffalo, New York, the temperature was –14°F in the morning. If the temperature dropped 7°F, what is the temperature now?
Answer: Drop: Subtract: –14 – 7 → add the opposite → –14 + –7 = –21°F
Why does this response make sense? Since the temperature dropped, it is going to be colder (–21°F is less than –14°F).

Applied Practice

Activity 1: For the following problems, indicate the key word that represents the operation and justify your response.

1) A submarine at –38 feet dives 50 feet. What is the submarine's elevation after the dive?
Dives: Subtraction: –88ft
Students may subtract 50 – 38, not understanding the submarine is already at a negative elevation.

2) A submarine was situated 800 feet below sea level. If it ascends 250 feet, what is its new position?
Students may not understand the word *ascends* and thus state –1050 ft.

3) The temperature on Monday was –15°F. The temperature on Tuesday was 6°F warmer. What was the temperature on Tuesday?
Many students think they need to subtract because it says "warmer"; they are not able to understand the concept that *warmer* means the temperature is rising/increasing, and therefore addition.

−15 + 6 = −9 °F on Tuesday, which is warmer (higher) than −15°F.

4) Metal mercury at room temperature is a liquid. Its melting point is −39°C. The freezing point of alcohol is ⁻114°C. How much warmer is the melting point of mercury than the freezing point of alcohol?

Activity 2: Have students create their own word problems using key words, then switch with a partner to solve each other's problems.

Misconceptions: Students may have difficulty remembering which color represents which type of number. Students may struggle with adding more then two integers in one problem.

Lesson Guidance (Day 8)

Agenda: Multiplying Rational Numbers

➢ Essential Question: How can mathematical operations with rational numbers help us make real-life decisions?

Goal: Students will investigate rules for multiplying rational numbers by following a pattern.
Warm-Up: Use your knowledge of patterns to fill in the blanks below:

3 x 3	9
3 x 2	6
3 x 1	3
3 x 0	0
3 x −1	
3 x −2	
3 x −3	
4 x 3	
4 x 2	
4 x 1	
4 x 0	
4 x −1	
4 x −2	
4 x −3	

1) Fill in the column on the right for the upper part of the table.

2) Apply the same knowledge to fill in the lower part of the table.

3) Describe the pattern for each table using a complete sentence.

Mini-Lesson:

Now focusing on the signs of the questions in the table and the responses that go with them, ask students to:

- Write a rule on how you would multiply two rational numbers when both factors are positive.

- Identify the number property that allows us to multiply a negative by a positive and would give the same

answer as multiplying a positive by a negative.

- Then write a rule on how you would multiply two rational numbers when the signs are different.

Ask students to help fill in the table using the information above and once again finding the pattern. The same questions should be asked in order to elicit a rule when multiplying two negative rational numbers.

−3 x 3	−9
−3 x 2	−6
−3 x 1	−3
−3 x 0	0
−3 x -1	
−3 x -2	
−3 x -3	
−4 x 3	
4 x 2	
4 x 1	
4 x 0	
4 x −1	
4 x −2	
4 x −3	

Once rules have been established, students assess fluency by using their knowledge of other rational numbers to apply their rules to different types of problems.

Work Period:
Assess for fluency first with different types of procedural questions such as:
1) Take the product of 3.6 and −19.2.
2) 7½ x 17¼

Then assign some real-world applications such as:
If Sally withdraws $37.29 four times a month for piano lessons, how much does she withdraw for a four-week month?
A hot air balloon starts on the ground and then rises 10,000 feet. What is the change in temperature at the altitude of the balloon? You can use the function $d = -6.7(a/2000)$ to calculate the change in temperature (d) in degrees Fahrenheit for an increase in altitude (a) measured in feet. (Idea from this problem was taken from the *Integrated Algebra* textbook; see "Resources" below.)

10,000 feet from ground to balloon

Closing: Mark was absent from class today. He will need you to summarize the rules for him so he can do his math homework tonight. Write a summary with examples so he can successfully complete his homework tonight.

RESOURCES:

Impact Math Grade 7: Working with Rational Numbers
Chapter 4: Students develop and apply algorithms for operations with signed numbers that include adding, subtracting, multiplying, and dividing.

Prentice Hall Integrated Algebra (supplementary)
Sections 2-1, 2-2, and 2-3. These sections include adding, subtracting, multiplying, and dividing rational numbers using a number line for addition and subtraction, adding an opposite for subtraction, and properties such as distributive property to teach multiplication.

Rational Number Initial Task:

a) The following expression is written on the board and the students are asked to simplify it:

$$-2\ 3/5\ +(1\ 1/5 + 4\ 5/8)$$

Faith says you can use the associative property of addition to simplify the expression. Is she correct? Simplify the expression to justify your answer.

b) The elevator in a mineshaft travels –150 feet per minute. How long would it take Jerome to ride the elevator to –525 feet? Show your work and explain why it is a negative distance.

c) A computer that originally cost $899 is on sale for 15% off. What is the sale price of the computer?

7.NS.1. Apply and extend previous understandings of addition to add rational numbers.
7.NS.2. Apply and extend previous understandings of multiplication of fractions to multiply rational numbers.
7.NS.3. Solve real-world and mathematical problems involving the four operations with rational numbers.

MP.3. Construct viable arguments and critique the reasoning of others.
MP.6. Attend to precision.

Rational Numbers Initial Task

Three-Point Score

The response accomplishes the prompted purposes and effectively communicates the student's understanding. The student's strategy and execution meet the content (including concepts, technical representations, and connections), thinking processes, and qualitative demands of all parts of the task. Omissions may exist, but do not detract from the correctness of the response. Minor arithmetic errors may be present, but no errors of reasoning appear.

Make sense of problems and persevere in solving them: Work includes representations of the problem indicating the student made sense of the problem and advanced toward a correct solution.

Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Critique the reasoning of others: Proves a response as correct or incorrect by using a number property. **Attend to precision:** Correctly adds and multiplies rational numbers.	Response indicates the ability to apply properties of operations as strategies to add and subtract rational numbers. A. Correctly adds positive and negative fractions and mixed numbers as 3 and 9/40. Identifies property as associative that can be used to prove correctness and critique the reasoning of another's response by using the identified property. B. Correctly divides rational numbers for a rate problem. The answer is 3.5 minutes. Explanation is necessary and should state why the answer is negative. C. Correctly finds the percent of a number by multiplying a percent by a rational number.

Two-Point Score

The response accomplishes the prompted purposes and effectively communicates the student's mathematical understanding. The student's strategy and execution meet the content (including concepts, technical representations, and connections), thinking processes, and qualitative demands of all parts of the task. Some necessary connections between the context and the operations with rational numbers may be missing.

Make sense of problems and persevere in solving them: Work includes representations of the problem indicating the student made sense of the problem and advanced toward a correct solution, but indicates struggle to interpret parts of the context correctly.

Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Critique the reasoning of others: Proves a response as correct or	Response indicates the ability to apply properties of operations as strategies to add and subtract rational numbers.

| | A. Incorrectly adds one out of the two operations for the positive and negative fractions and mixed numbers. Incorrectly identifies property that can be used to prove correctness or does not critique the reasoning of another's response by using the identified property. |
incorrect by using a number property.	
	B. Incorrectly multiplies rational numbers for a rate problem. Explanation is necessary and should state why answer is negative.
Attend to precision: Correctly adds and multiplies rational numbers.	C. Incorrectly finds the percent of a number when multiplying a percent by a rational number.

One-Point Score

The response accomplishes some of the prompted purposes and communicates the student's mathematical understanding. The student's strategy and execution meet only a few of the content demands of the task. The necessary connections between the operations with rational numbers and the context are missing.

Makes sense of problems and persevere in solving them:	
Work is missing representations of the problem or understanding of the constraints of the problem given in the context.	
Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**

Critique the reasoning of others: Proves a response as correct or incorrect by using a number property.
 	
Attend to precision: Correctly adds and multiplies rational numbers.
	Response indicates the ability to apply properties of operations as strategies to add and subtract rational numbers.
	  A. Incorrectly adds positive and negative fractions and mixed numbers. Misidentifies property that can be used to prove correctness.
	  B. Incorrectly multiplies rational numbers for a rate problem. Explanation is not included or is incorrect.
	  C. Incorrectly finds the percent of a number when multiplying a percent by a rational number.

Grade 7: Protons and Electrons

a) Atoms must have the same number of protons and neutrons, but when an atom gains electrons, it becomes an anion. A nitrogen anion has 7 protons and 10 electrons. Each proton has a charge of +1 and each electron has a charge of −1. What is the total charge of the atom? Include a mathematical sentence or equation to show your work. Explain how you knew your answer was correct.

b) Use the number line to determine the sum of the protons and electrons in the nitrogen anion.

$$\longleftarrow\text{---}\longrightarrow$$

−15	−10	−5	0	5	10	15
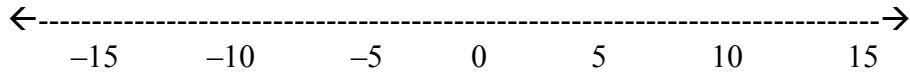
c) If a magnesium anion has a total charge of −2, determine the difference between a nitrogen anion and a magnesium anion. Show all your work.

7.NS.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.
7.NS.3. Solve real-world and mathematical problems involving addition and subtraction with rational numbers.

MP.1. Make sense of problems and persevere in solving them.
MP.2. Reason abstractly and quantitatively.
MP.4. Model with mathematics.
MP.6. Attend to precision.

Grade 7: Electrons and Protons Task

Three-Point Score

The response accomplishes the prompted purposes and effectively communicates the student's understanding. The student's strategy and execution meet the content (including concepts, technical representations, and connections), thinking processes, and qualitative demands of all parts of the task. Omissions may exist, but do not detract from the correctness of the response. Minor arithmetic errors may be present, but no errors of reasoning appear.

Make sense of problems and persevere in solving them: Work includes representations of the problem indicating the student made sense of the problem and advanced toward a correct solution.	
Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Reason abstractly and quantitatively: Correctly abstracts information from the word problems to create mathematical representations of the problems. Correctly applies properties of operations as strategies to add and subtract rational numbers. **Model with mathematics:** A number line is required to demonstrate adding two rational numbers. **Attend to precision:** Correctly adds and subtracts rational numbers.	Response indicates the ability to apply properties of operations as strategies to add and subtract rational numbers. A. Identify an electron as a negative number and a proton as a positive number and add them to find the total charge of the atom. Positive 7 and –10 when added equals –3. The answer must be explained as well as an equation included to show how the answer is obtained. B. Correctly abstracts information from Part A and demonstrates how to add +7 and –10 using a number line. The number line must show beginning at +7, adding –10, and ending at –3. C. Correctly abstracts information from the word problem to find the difference of the answer from Part A with a new total atom charge. The difference between a nitrogen anion –3 and magnesium anion –2 can be written as an expression: $-3 - -2 = -1$.

Two-Point Score

The response accomplishes the prompted purposes and effectively communicates the student's mathematical understanding. The student's strategy and execution meet the content (including concepts, technical representations, and connections), thinking processes, and qualitative demands of all parts of the task. Some necessary connections between the context and the operations with rational numbers may be missing.

Make sense of problems and persevere in solving them: Work includes representations of the problem indicating the student made sense of the

problem and advanced toward a correct solution, but indicates struggle to interpret parts of the context correctly.	
Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Reason abstractly and quantitatively: Correctly abstracts information from the word problems to create mathematical representations of the problems. Correctly applies properties of operations as strategies to add and subtract rational numbers. **Model with mathematics:** A number line is required to demonstrate adding two rational numbers. **Attend to precision:** Correctly adds and subtracts rational numbers.	Response indicates the ability to apply properties of operations as strategies to add and subtract rational numbers. A. Incorrectly identifies an electron as a positive number and takes the sum of the 7 and 10 to give an answer of 17. The answer must be explained as well as an equation included to show how the answer is obtained. The student may also incorrectly find the sum of +7 and −10 but correctly explains the method. B. Correctly abstracts information from Part A and incorrectly demonstrates how to add +7 and −10 using a number line. The number line may not show beginning at +7, adding −10, and ending at −3. C. Incorrectly abstracts information from the word problem to find the sum instead of difference of the answer from Part A with a new total atom charge. The difference between a nitrogen anion −3 and magnesium anion −2 can be written as an expression: $-3 - -2 = -1$. If student takes the sum, the answer will be −5.

One-Point Score

The response accomplishes some of the prompted purposes and communicates the student's mathematical understanding. The student's strategy and execution meet only a few of the content demands of the task. The necessary connections between the operations with rational numbers and the context are missing.

Makes sense of problems and persevere in solving them: Work is missing representations of the problem or understanding of the constraints of the problem given in the context.	
Mathematical Practices	**Evidenced-Based Traits: Mathematical Content**
Reason abstractly and quantitatively: Correctly abstracts information from the word problems to create mathematical representations of the problems. Correctly applies	Response indicates the ability to apply properties of operations as strategies to add and subtract rational numbers. A. Incorrectly identifies the positive or negative charge of electrons and protons, which will lead to an incorrect answer as well as

properties of operations as strategies to add and subtract rational numbers. **Model with mathematics:** A number line is required to demonstrate adding two rational numbers. **Attend to precision:** Correctly adds and subtracts rational numbers.	incorrectly finding the difference or sum (two or more conceptual errors). The answer is not explained well; it does not include an equation to show how the answer was obtained. B. Incorrectly abstracts information from Part A and does not demonstrate how to add +7 and −10 using a number line. C. Incorrectly abstracts information from the word problem to find the sum of the answer from Part A with a new total atom charge.