ZEARN Math

MISSION OVERVIEW

GRADE 7

M5 Rational Number Arithmetic

Introduction

In this Mission, students interpret signed numbers in contexts (e.g., temperature, elevation, deposit and withdrawal, position, direction, speed and velocity, percent change) together with their sums, differences, products, and quotients. ("Signed numbers" include all rational numbers, written as decimals or in the form $\frac{a}{b}$.) Students use tables and number line diagrams to represent sums and differences of signed numbers or changes in quantities represented by signed numbers such as temperature or elevation, becoming more fluent in writing different numerical addition and subtraction equations that express the same relationship. They compute sums and differences of signed numbers. They plot points in the plane with signed number coordinates, representing and interpreting sums and differences of coordinates. They view situations in which objects are traveling at constant speed (familiar from previous Missions) as proportional relationships. For these situations, students use multiplication equations to represent changes in position on number line diagrams or distance traveled, and interpret positive and negative velocities in context. They become more fluent in writing different numerical multiplication and division equations for the same relationship. Students extend their use of the "next to" notation (which they used in expressions such as $5x$ and $6(3+2)$ in grade 6) to include negative numbers and products of numbers, e.g., writing $-5x$ and $(-5)(-10)$ rather than $(-5) \cdot (x)$ and $(-5) \cdot (-10)$. They extend their use of the fraction bar to include variables as well as numbers, writing $-8.5 \div x$ as well as $\frac{-8.5}{x}$.

Overview of Topics and Lesson Objectives

Each mission is broken down into topics. A topic is a group of lessons that teach the same concept. There is a balance of Independent Digital Lessons and Concept Explorations in each topic of a mission to ensure every student learns with a mix of modalities, feedback, and support while engaging in grade-level content. Throughout each mission, students work on grade-level content with embedded remediation to address unfinished learnings.

	Objective	INDEPENDENT DIGITAL LESSON	CONCEPT EXPLORATION
Topic A	**Interpreting Negative Numbers**		
Lesson 1	Interpret signed numbers in the context of temperature and elevation.	✓	✓
Topic B	**Adding and Subtracting Rational Numbers**		
Lesson 2	Use a number line to add positive and negative numbers.	✓	✓
Lesson 3	Understand how to add positive and negative numbers in general.	✓	✓
Lesson 4	Understand what positive and negative numbers mean in a situation involving money and calculate an account balance after a deposit or withdrawal.	✓	✓
Lesson 5	Use a number line to subtract positive and negative numbers.	✓	✓
Lesson 6	Solve subtraction expressions that have the same numbers in the opposite order, and explaint he relationship between their differences.	✓	✓
Lesson 7	Add and subtract signed numbers to represent gains and losses in different contexts.	✓	✓
Mid-Mission Assessment: Topics A-B			
Topic C	**Multiplying and Dividing Rational Numbers**		
Lesson 8	Understand that the product of a negative number and positive number is negative and explain how signed numbers can be used to represent position and speed.	✓	✓
Lesson 9	Interpret signed numbers when used to represent time in situations about speed and direction as well as understand that the product of two negative numbers is positive.	✓	✓

	Objective	INDEPENDENT DIGITAL LESSON	CONCEPT EXPLORATION
Lesson 10	Multiply rational numbers, including expressions with 3 factors.	X	OPTIONAL
Lesson 11	Use the relationship between multiplication and division to develop the rules for dividing rational numbers.	✓	✓
Lesson 12	Multiply and divide rational numbers to solve problems involving constant rates.	X	✓
Topic D	**Four Operations with Rational Numbers**		
Lesson 13	Use the relationship between addition and subtraction, and the relationship between multiplication and division, to evaluate expressions with all four operations on the rational numbers.	✓	✓
Lesson 14	Interpret situations involving rational numbers, including positive and negative values, and use rational numbers to represent and solve problems.	✓	✓
Topic E	**Solving Equations Where There are Negative Numbers**		
Lesson 15	Solve equations that involve negative numbers.	✓	✓
Lesson 16	Write and solve equations to represent situations that involve negative numbers.	✓	✓
Topic F	**Let's Put It to Work**		
Lesson 17	Use positive and negative numbers to represent directed change.	X	✓
End-of-Mission Assessment: Topics C-F			

Foundational Missions

For each mission, Zearn Math highlights the foundational missions, the earlier content where concepts are introduced and developed. Teachers can access foundational missions directly from the mission page of their Teacher Account to address any unfinished learnings. Zearn recommends that teachers assign foundational missions during Flex Day or during additional non-core instruction time. It is important to use a foundational mission to support students who are struggling, rather than an unaligned mission, because the content students learn in each foundational mission supports their Core Day learning.

Foundational Mission(s) for G7M5: G6M4 Topic C, G6M5 Topics B-D, G6M7 Topic A

Mission Overview

In grade 6, students learned that the rational numbers comprise positive and negative fractions. They plotted rational numbers on the number line and plotted pairs of rational numbers in the coordinate plane. In this mission, students extend the operations of addition, subtraction, multiplication, and division from fractions to all rational numbers, written as decimals or in the form $\frac{a}{b}$.

The mission begins by revisiting ideas familiar from grade 6: how signed numbers are used to represent quantities such as measurements of temperature and elevation, opposites (pairs of numbers on the number line that are the same distance from zero), and absolute value.

In the second Topic of the mission, students extend addition and subtraction from fractions to all rational numbers. They begin by considering how changes in temperature and elevation can be represented—first with tables and number line diagrams, then with addition and subtraction expressions and equations. Initially, physical contexts provide meanings for sums and differences that include negative numbers. Students work with numerical addition and subtraction expressions and equations, becoming more fluent in computing sums and differences of signed numbers. Using the meanings that they have developed for addition and subtraction of signed numbers, they write equivalent numerical addition and subtraction expressions, e.g., -8 + -3 and -8 − 3; and they write different equations that express the same relationship.

The third Topic of the mission focuses on multiplication and division. It begins with problems about position, direction, constant speed, and constant velocity in which students represent quantities with number line diagrams and tables of numerical expressions with signed numbers. This allows products of signed numbers to be interpreted in terms of position and direction, using the understanding that numbers that are additive inverses are located at the same distance but opposite sides of the starting point. These examples illustrate how multiplication of how multiplication of fractions extends to rational numbers. The third lesson of this Topic focuses on computing products of signed numbers and is optional. In the fourth lesson, students use the relationship between multiplication and division to understand how division extends to rational numbers. In the process of solving problems set in contexts, they write and solve multiplication and division equations.

In the fourth Topic of the mission, students work with expressions that use the four operations on rational numbers, making use of structure, e.g., to see without calculating that the product of two factors is positive because the values of the factors are both negative. They extend their use of the "next to" notation (which they used in expressions such as $5x$ and $6(3 + 2)$ in grade 6) to include negative numbers and products of numbers, e.g., writing $-5x$ and $(-5)(-10)$ rather than $(-5) \cdot (x)$ and $(-5) \cdot (-10)$. They extend their use of the fraction bar to include variables as well as numbers, writing $-8.5 \div x$ as well as $\frac{-8.5}{x}$. They solve problems that involve interpreting negative numbers in context, for instance, when a negative number represents a rate at which water is flowing.

In the fifth Topic of the mission, students begin working with linear equations in one variable that have rational number coefficients. The focus of this Topic is representing situations with equations and what it means for a number to be a solution for an equation, rather than methods for solving equations. Such methods are the focus of a later mission.

The last Topic of the mission is a lesson in which students use rational numbers in the context of stock-market situations, finding values of quantities such as the value of a portfolio or changes due to interest and depreciation.

Note. In these materials, an *expression* is built from numbers, variables, operation symbols (+, −, ·, ÷), parentheses, and exponents. (Exponents—in particular, negative exponents—are not a focus of this mission. Students work with integer exponents in grade 8 and non-integer exponents in high school.) An *equation* is a statement that two expressions are equal, thus always has an equal sign. *Signed numbers* include all rational numbers, written as decimals or in the form $\frac{a}{b}$.

Progression of Disciplinary Language

In this mission, teachers can anticipate students using language for mathematical purposes such as interpreting, representing, and generalizing. Throughout the mission, students will benefit from routines designed to grow robust disciplinary language, both for their own sense-making and for building shared understanding with peers. Teachers can formatively assess how students are using language in these ways, particularly when students are using language to:

Interpret

- situations involving signed numbers (throughout Mission)
- tables with signed numbers (Lesson 3)
- bank statements with signed numbers (Lesson 4)

Represent

- addition of signed numbers on a number line (Lesson 2)
- situations involving signed numbers (Lessons 3 and 11)
- changes in elevation (Lesson 6)
- position, speed, and direction (Lesson 8)

Generalize

- about subtracting and adding signed numbers (Lesson 5)
- about differences and magnitude (Lesson 6)
- about multiplying negative numbers (Lesson 9)
- about additive and multiplicative inverses (Lesson 15)

In addition, students are expected to justify reasoning about distances on a number line and about negative numbers, account balances, and debt. Students are also expected to explain how to determine changes in temperature, how to find information using inverses, and how to model situations involving signed numbers.

The table shows lessons where new terminology is first introduced, including when students are expected to understand the word or phrase receptively and when students are expected to produce the word or phrase in their own speaking or writing. Terms from the glossary appear bolded. Teachers should continue to support students' use of a new term in the lessons that follow where it was first introduced.

New Terminology		
Lesson	**Receptive**	**Productive**
1	degrees Celsius vertical elevation sea level	negative
2	absolute value signed numbers	temperature number line
3	sum opposite expression	
4	**deposit** **withdrawal** account balance debt	
6	difference	distance
7	solution (to an equation)	*x*-coordinate *y*-coordinate
8	velocity	absolute value
11	factor	
13	rational number	sum difference
15	variable additive inverse multiplicative inverse	opposite solution (to an equation)
16	operation	
17		increase decrease

Terminology

Deposit

When you put money into an account, it is called a deposit.

For example, a person added $60 to their bank account. Before the deposit, they had $435. After the deposit, they had $495, because 435 + 60 = 495.

Withdrawal

When you take money out of an account, it is called a withdrawal.

For example, a person removed $25 from their bank account. Before the withdrawal, they had $350. After the withdrawal, they had $325, because 350 − 25 = 325.

Required Materials

Four-function calculators

Templates

pre-printed slips, cut from copies of the template

Lesson 13 Activity 1

Lesson 15 Activity 3

Lesson 17 Activity 3