

Adding and Subtracting to Solve Problems

Goals

- Apply addition and subtraction of signed numbers to solve problems in an unfamiliar context, and explain (orally and in writing) the solution method.
- Interpret signed numbers used to represent gains or losses in an unfamiliar context.

Learning Target

I can solve problems that involve adding and subtracting rational numbers.

Student Learning Goal

Let's apply what we know about signed numbers to different situations.

Lesson Narrative

In this lesson, students apply what they have learned about adding and subtracting signed numbers to represent situations and solve problems. First, they examine a situation in which changes in inventory are represented with positive and negative numbers. They interpret what the numbers mean in the context and calculate the new inventory amount after the next change. Then, students write expressions to represent multiple, sequential changes in elevation. This builds on previous lessons where students worked with representing one change in elevation at a time. As students explain how the expressions represent the situations, they construct arguments and critique the reasoning of others.

The last activity is optional because it provides an opportunity for additional practice with finding distances and differences in a geometric context.

Access for Students with Diverse Abilities

- Engagement (Activity 2)
- Representation (Activity 1)

Access for Multilingual Learners

- MLR7: Compare and Connect (Activity 2)

Instructional Routines

- MLR7: Compare and Connect
- Notice and Wonder

Required Preparation

Activity 3:

For the digital version of the activity, acquire devices that can run the applet.

Lesson Timeline

5 min

Warm-up

10 min

Activity 1

15 min

Activity 2

15 min

Activity 3

10 min

Lesson Synthesis

Assessment

5 min

Cool-down

Instructional Routines

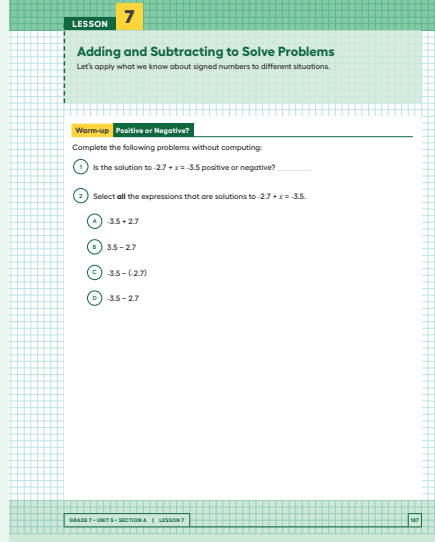
Notice and Wonder

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Student Workbook



Warm-up

Positive or Negative?

5 min

Activity Narrative

In this *Warm-up*, students reason about the sign of the solution to an equation which has positive and negative rational numbers. They also find expressions that can be used to solve the given equation.

Launch

Arrange students in groups of 2. Give students 30 seconds of quiet think time, and ask them to give a signal when they have an answer and a strategy for the first question. Then have them discuss their reasoning with a partner. Ask for an explanation, and then ask if everyone agrees with that reasoning.

Then give students 30 seconds of quiet think time, and ask them to give a signal when they have an answer for the second question. Then have them discuss their reasoning with a partner.

Student Task Statement

Complete the following problems without computing:

1. Is the solution to $-2.7 + x = -3.5$ positive or negative?

negative

2. Select **all** the expressions that are solutions to $-2.7 + x = -3.5$.

A. $-3.5 + 2.7$

B. $3.5 - 2.7$

C. $-3.5 - (-2.7)$

D. $-3.5 - 2.7$

Activity Synthesis

Poll the class for which expressions they chose for the second question. Discuss until everyone is in agreement about the answer to the second question.

Activity 1

Phone Inventory

10 min

Activity Narrative

In this activity, positive and negative numbers are used to represent changes in a quantity. Students consider a table showing the changes in inventory of cell phones at one store and make sense of it in the given context.

Launch

Tell students to close their books or devices (or to keep them closed). Display the table from the *Task Statement* for all to see. Give students 1 minute of quiet think time, and ask them to be prepared to share at least one thing they notice and one thing they wonder. Record and display responses without editing or commentary for all to see. If possible, record the relevant reasoning on or near the table.

If the meaning of positive and negative numbers in this context does not come up during the conversation, ask students to discuss this idea.

Tell students to open their books or devices and finish the rest of the questions. Follow with a brief whole-class discussion.

Student Task Statement

A store tracks the number of cell phones it has in stock and how many phones it sells.

The table shows the inventory for one phone model at the beginning of each day last week. The inventory changes when they sell phones or get shipments of phones into the store.

	inventory	change
Monday	18	-2
Tuesday	16	-5
Wednesday	11	-7
Thursday	4	-6
Friday	-2	20

1. What do you think it means when the change is positive? Negative?
Sample response: The inventory increases; the inventory decreases.
2. What do you think it means when the inventory is positive? Negative?
Sample response: There are phones in the store that people can buy; someone ordered a phone but they are waiting for one to come into the store.
3. Based on the information in the table, what do you think the inventory will be on Saturday morning? Explain your reasoning.
Sample response: 18. Sample reasoning: The inventory on any given day is the sum of the inventory and the change on the previous day.
4. What is the difference between the greatest inventory and the least inventory?
Sample response: The difference is 20, because $18 - (-2) = 20$

Activity Synthesis

The purpose of this discussion is for students to share their thinking about what positive and negative numbers mean in the context of inventory and change. Begin by inviting students to share their responses and reasoning for the first two questions. Consider discussing the following questions:

Access for Students with Diverse Abilities (Activity 1, Launch)

Representation: Access for Perception.
Invite students to act out the scenario of a store selling and restocking phones, using physical manipulatives. Emphasize how the direction the manipulatives are moving corresponds to the sign of the change.

Supports accessibility for: Language, Conceptual Processing

Student Workbook

1 Phone Inventory

A store tracks the number of cell phones it has in stock and how many phones it sells. The table shows the inventory for one phone model at the beginning of each day last week. The inventory changes when they sell phones or get shipments of phones into the store.

	inventory	change
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Wednesday	11	-7
Thursday	4	-6
Friday	-2	20

1

What do you think it means when the change is positive? Negative?

2

What do you think it means when the inventory is positive? Negative?

3

Based on the information in the table, what do you think the inventory will be on Saturday morning? Explain your reasoning.

4

What is the difference between the greatest inventory and the least inventory?

Instructional Routines

MLR7: Compare and Connect

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Access for Multilingual Learners

MLR7: Compare and Connect

This activity uses the *Compare and Connect* math language routine to advance representing and conversing as students use mathematically precise language in discussion.

“What is the difference between the -2 in the inventory column and the -2 in the change column?”

One represents that 2 phones have been ordered but are not available in inventory, while the other represents the number of phones that were sold on Monday.

“What is the difference between a positive number in the inventory column and a positive number in the change column?”

A positive inventory means that the store has the cell phone in stock, while a positive change means that the store gets a shipment of phones that day.

If time allows, invite students to share their responses and reasoning for the remaining questions.

Activity 2

Climbing Mount Kilimanjaro

15
min

Activity Narrative

In this activity, students track the elevation changes of a hiker on Mount Kilimanjaro. Students are free to use any strategy to determine the hiker's beginning or final elevation or their change in elevation for each given day, but they must be able to explain their reasoning.

Monitor for students who use these different strategies for the last problem about the difference between the hiker's final and beginning elevations.

- Drawing a number line diagram
- Finding the final elevation by adding or subtracting the meters hiked up or down, then finding the difference between the final and beginning elevations
- Finding the difference between the meters hiked up and the meters hiked down

Launch

Read aloud the first three sentences of the first problem:

“A hiker is climbing Mount Kilimanjaro. On day 2, the hiker starts at an elevation of 2,785 meters. He hikes up 278 meters, down 87 meters, up 548 meters, and back down 20 meters.”

Ask students,

“How could we represent the hiker's elevation?”

Invite several students to share possible representations.

arithmetic expression, number line

If not mentioned by students, display the expression $2,785 + 278 + -87 + 548 + -20$. Ask students to interpret what the negative numbers in this expression represent.

distances the hiker is climbing down

Give students 4–5 minutes of quiet work time followed by time for partner discussion. Follow with a whole-class discussion.

Student Task Statement

For each problem, use at least one negative number to represent the situation. Then, answer the question, and explain or show your reasoning.

1. A hiker is climbing Mount Kilimanjaro. On day 2, the hiker starts at an elevation of 2,785 meters. He hikes up 278 meters, down 87 meters, up 548 meters, and back down 20 meters. What elevation does he end the day at?

3,504 meters

Sample reasoning: Climbing up: $278 + 548 = 826$. Climbing down: $-87 + -20 = -107$. Overall change: $2,785 + 826 + -107 = 3,504$.

2. On day 4, he hikes up 732 meters to Lava Tower and then back down 641 meters. He ends the day at an elevation of 3,986 meters. What elevation did he start the day at?

3,895 meters

Sample reasoning: $x + 732 + -641 = 3,986$, where x represents the starting elevation. $x + 91 = 3,986$, so $x = 3,986 - 91$.

3. On day 6, he starts at an elevation of 4,662 meters. He hikes 1,233 meters up to Uhuru Peak and then 2,789 meters back down. What is the difference between his final and beginning elevations that day?

-1,556 meters

Sample reasoning: To find the final elevation: $4,662 + 1,233 + -2,789 = 3,106$. To find the difference: $3,106 - 4,662 = -1,556$.

Activity Synthesis

The goal of this discussion is for students to make connections between different representations of a situation. Display 2–3 approaches from previously selected students for all to see. Use *Compare and Connect* to help students compare, contrast, and connect the different approaches. Here are some questions for discussion:

“What do the approaches have in common? How are they different?”

“Did anyone solve the problem the same way but would explain it differently?”

“How does the hiker’s beginning and final elevation show up in each method, if at all?”

“Are there any benefits or drawbacks to one representation compared to another?”

Access for Students with Diverse Abilities (Activity 2, Student Task)

Engagement: Develop Effort and Persistence.

Encourage and support opportunities for peer collaboration. When students share their work with a partner, display sentence frames to support conversation, such as “_____ represents _____” “One thing that is the same is …” “One thing that is different is …” or “Where does _____ show …?”


Supports accessibility for: Language, Social-Emotional Functioning

Student Workbook

2 Climbing Mount Kilimanjaro

For each problem, use at least one negative number to represent the situation. Then, answer the question, and explain or show your reasoning.

1 A hiker is climbing Mount Kilimanjaro. On day 2, the hiker starts at an elevation of 2,785 meters. He hikes up 278 meters, down 87 meters, up 548 meters, and back down 20 meters. What elevation does he end the day at?



2 On day 4, he hikes up 732 meters to Lava Tower and then back down 641 meters. He ends the day at an elevation of 3,986 meters. What elevation did he start the day at?

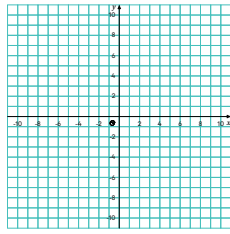
3 On day 6, he starts at an elevation of 4,662 meters. He hikes 1,233 meters up to Uhuru Peak and then 2,789 meters back down. What is the difference between his final and beginning elevations that day?

GRADE 7 • UNIT 5 • SECTION A | LESSON 7

Student Workbook

Differences and Distances

Plot and label these points in the coordinate plane: $A(5, 4)$, $B(5, -2)$, $C(-3, -2)$, $D(-3, 4)$.



1. Connect the dots in order. What shape is made?
2. What are the side lengths of figure $ABCD$?
3. What is the difference between the x -coordinates of B and C ?
4. What is the difference between the x -coordinates of C and B ?
5. How do the differences of the coordinates relate to the distances between the points?

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GRADE 7 • UNIT 5 • SECTION A | LESSON 7

Activity 3: Optional

Differences and Distances

15 min

Activity Narrative

There is a digital version of this activity.

In this activity, students plot points in a coordinate plane to create a rectangle. They find the lengths of each side by finding the horizontal or vertical distance between points. Students attend to precision in language as they distinguish between *distance* (which is unsigned) and *difference* (which is signed).

In the digital version of the activity, students use an applet to plot points in a coordinate plane. The digital version may reduce barriers for students who need support with fine-motor skills.

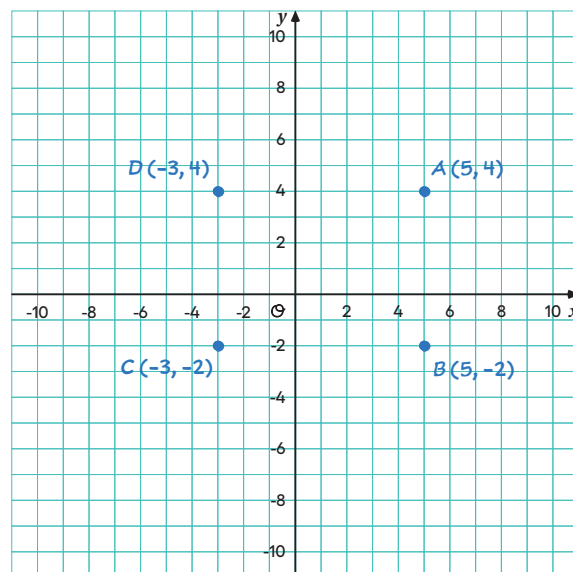
Launch



Arrange students in groups of 2. Give students 5 minutes of quiet work time followed by a partner discussion. Then follow with a whole-class discussion.

Student Task Statement

Plot and label these points in the coordinate plane: $A(5, 4)$, $B(5, -2)$, $C(-3, -2)$, $D(-3, 4)$.



1. Connect the dots in order. What shape is made?
a rectangle
2. What are the side lengths of figure $ABCD$?
6 units and 8 units
3. What is the difference between the x -coordinates of B and C ?
8

4. What is the difference between the x -coordinates of C and B ?

-8

5. How do the differences of the coordinates relate to the distances between the points?

The absolute value of the difference is the distance.

Activity Synthesis

The goal of this discussion is for students to compare the *distance* between two numbers with the *difference* between two numbers. Here are some questions for discussion:

“How can you find the difference between two numbers?”

Subtract one number from the other.

“When finding the difference between two numbers, does the order matter?”

Yes, we need to subtract the final number from the beginning number.

“How can we find the distance between two numbers?”

We can use a number line and count the distance between the two numbers.
We can subtract the two numbers.

“When finding the distance between two numbers, does the order matter?”

No, we are just looking for the magnitude of the change, not the direction of the change.

“How can we see this distinction between **difference** and **distance** in the points we drew in the coordinate plane?”

When finding the difference between the x -coordinates of B and C , the order we subtracted mattered, but when finding the distance between the two points, the order did not matter.

If not mentioned in students' explanations, emphasize that differences can be positive or negative (or 0) depending on the order of the numbers subtracted. Distances can not be negative.

Lesson Synthesis

Share with students,

“Today we used positive and negative numbers to represent situations and solve problems.”

To review the various types of situations that students have seen represented with signed numbers, consider asking:

“What are some types of contexts we have seen represented with signed numbers?”

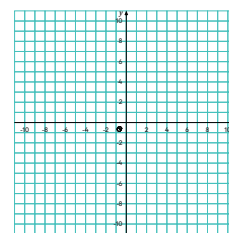
temperature, elevation, money, inventory

“What does a negative number mean in each of these contexts?”

Student Workbook

Differences and Distances

Plot and label these points in the coordinate plane: $A(5, 4)$, $B(5, -2)$, $C(-3, -2)$, $D(-3, 4)$.



1. Connect the dots in order. What shape is made?
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4. What is the difference between the x -coordinates of C and B ?
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GRADE 7 • UNIT 5 • SECTION A | LESSON 7

Student Workbook

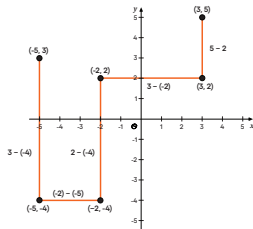
Lesson Summary

Sometimes we use positive and negative numbers to represent quantities in context. Here are some contexts we have studied that can be represented with positive and negative numbers:

- Temperature
- Elevation
- Money
- Inventory

Using positive and negative numbers (and operations on positive and negative numbers) helps us understand and analyze the situations in context. To solve problems in these situations, we just have to understand what it means when a quantity is positive, what it means when a quantity is negative, and what it means to add and subtract quantities.

When two points in the coordinate plane lie on a horizontal line, we can find the distance between them by subtracting their x -coordinates. When two points in the coordinate plane lie on a vertical line, we can find the distance between them by subtracting their y -coordinates.



Remember: The distance between two numbers is independent of the order, whereas the difference depends on the order.

GRADE 7 • UNIT 5 • SECTION A | LESSON 7

Sample responses:

- A negative temperature means it is colder than 0° . A negative change in temperature means getting colder.
- A negative elevation can mean below sea level. A negative change in elevation means getting lower.
- A negative amount of money can mean a debt. A negative change in money can mean a withdrawal.
- A negative number for inventory can mean that items that are out of stock have been sold and the orders still need to be fulfilled. A negative change in inventory can mean items were sold.

Lesson Summary

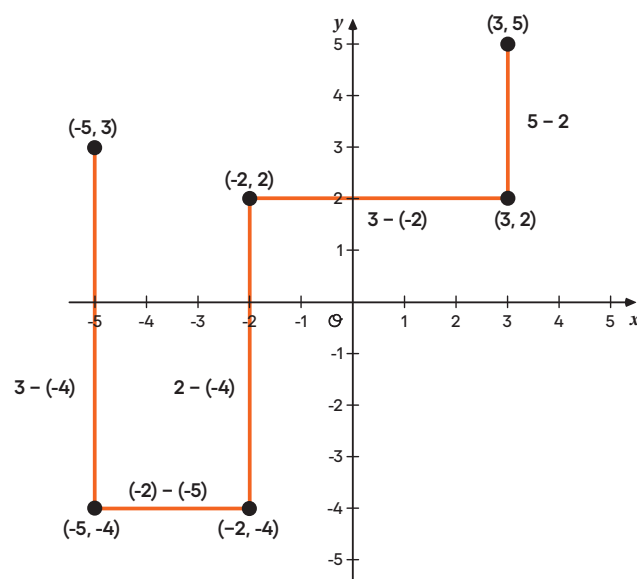
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When two points in the coordinate plane lie on a horizontal line, we can find the distance between them by subtracting their x -coordinates.

When two points in the coordinate plane lie on a vertical line, we can find the distance between them by subtracting their y -coordinates.



Remember: The *distance* between two numbers is independent of the order, whereas the *difference* depends on the order.

Cool-down

Coffee Shop Cups

5

min

Student Task Statement

Here is some record keeping from a coffee shop about their paper cups. Cups are delivered 2,000 at a time.

day	change
Monday	+2,000
Tuesday	-125
Wednesday	-127
Thursday	+1,719
Friday	-356
Saturday	-782
Sunday	0

1. Explain what a positive and negative number means in this situation.
Sample response: Positive might mean the number of cups delivered or delivered minus used. Negative might mean the number of cups used.
2. Assume the starting amount of coffee cups is 0. How many paper cups are left at the end of the week?
2,329 cups
3. How many cups do you think were used on Thursday? Explain how you know.
281
Sample reasoning: It looks like some were delivered and some were used. Since they are delivered 2,000 at a time, $2,000 - 1,719$ would be the number used.

Responding To Student Thinking

Points to Emphasize
If students struggle with adding and subtracting signed numbers, review this concept as opportunities arise over the next several lessons. For example, invite multiple students to share their thinking about the addition and subtraction problems in these activities:
Grade 7, Unit 5, Lesson 13, Activity 1
Card Sort: The Same but Different
Grade 7, Unit 5, Lesson 14, Activity 1
Scoring Margins

Practice Problems

5 Problems

Student Workbook

LESSON 7
PRACTICE PROBLEMS

1. When the table here is complete, it shows four transactions and the resulting account balance in a bank account. Fill in the missing numbers.

	transaction amount	account balance
transaction 1	360	360
transaction 2	-22.50	337.50
transaction 3		182.35
transaction 4		-41.40

2. The departure from the average amount of rain is the difference between the actual amount of rain and the average amount of rain for a given month. The historical average for rainfall in Albuquerque, NM, for June, July, and August is shown in the table.

June	July	August
0.67	1.5	1.57

- a. Last June only 0.17 inches of rain fell all month. What is the difference between the average rainfall and the actual rainfall for last June? _____
- b. The departure from the average rainfall last July was -0.36 inches. How much rain fell last July? _____
- c. How much rain would have to fall in August so that the total amount of rain equals the average rainfall for these three months? What would the departure from the average be in August in that situation? _____

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GRADE 7 • UNIT 5 • SECTION A | LESSON 7

Problem 1

When the table here is complete, it shows four transactions and the resulting account balance in a bank account. Fill in the missing numbers.

	transaction amount	account balance
transaction 1	360	360
transaction 2	-22.50	337.50
transaction 3	-155.15	182.35
transaction 4	-223.75	-41.40

Problem 2

The *departure from the average* amount of rain is the difference between the actual amount of rain and the average amount of rain for a given month. The historical average for rainfall in Albuquerque, NM, for June, July, and August is shown in the table.

June	July	August
0.67	1.5	1.57

- a. Last June only 0.17 inches of rain fell all month. What is the difference between the average rainfall and the actual rainfall for last June?

0.5 inches, because $0.67 - 0.17 = 0.50$

- b. The departure from the average rainfall last July was -0.36 inches. How much rain fell last July?

1.14 inches

Because the departure from average was negative, the actual rainfall needed to be 0.36 inches less than the average rainfall.

- c. How much rain would have to fall in August so that the total amount of rain equals the average rainfall for these three months? What would the departure from the average be in August in that situation?

2.43 inches and 0.86 inches

The departure from the average was -0.5 inches in June and -0.36 inches in July, so for those two months it was

$-0.5 + (-0.36) = -0.86$. So it will have to rain 0.86 more inches than usual in August to make that up. The departure from the average will be 0.86, and $0.86 + 1.57 = 2.43$.

Problem 3

from Unit 5, Lesson 6

A person travels from Lake Assal, Djibouti, where the elevation is -155 meters, to Elidar, Ethiopia, where the elevation is 418 meters. What is the difference between the person’s final elevation and their starting elevation?

573 meters, because $418 - (-155) = 573$

Problem 4

from Unit 4, Lesson 10

Tyler orders a meal that costs \$15.

a. If the tax rate is 6.6%, how much will the sales tax be on Tyler’s meal?

\$0.99, because $15 \cdot 0.066 = 0.99$

b. Tyler also wants to leave a tip for the server. How much do you think he should pay in all? Explain your reasoning.

Sample response: I think Tyler should pay \$19 in all because that would cover his meal, the sales tax, and a 20% tip for the server.

Problem 5

from Unit 2, Lesson 3

In a video game, a character is healed at a constant rate as long as they are standing in a certain circle. Complete the table.

time in circle (seconds)	health gained (points)
4	100
10	250
3	75
40	1,000

Student Workbook

7 Practice Problems

from Unit 5, Lesson 6

A person travels from Lake Assal, Djibouti, where the elevation is -155 meters, to Elidar, Ethiopia, where the elevation is 418 meters. What is the difference between the person's final elevation and their starting elevation?

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from Unit 2, Lesson 3

In a video game, a character is healed at a constant rate as long as they are standing in a certain circle. Complete the table.

time in circle (seconds)	health gained (points)
4	100
10	
3	
	1,000

Learning Targets

+ I can solve problems that involve adding and subtracting rational numbers.

GRADE 7 • UNIT 5 • SECTION A | LESSON 7

