Lesson 4

Ordering Rational Numbers

Goals

- Compare rational numbers without a context, and express (orally and in writing) the comparisons using the phrases "greater than," "less than," and "opposite."
- Comprehend that all negative numbers are less than all positive numbers.
- Order rational numbers from least to greatest, and explain (orally and through other representations) the reasoning.

Learning Targets

- I can compare and order rational numbers.
- I can use phrases like "greater than," "less than," and "opposite" to compare rational numbers.

Lesson Narrative

In this lesson, students practice ordering rational numbers and use precise language to describe the relationships between numbers plotted on a number line.

Students begin by using the symbol <, >, or = to compare pairs of numbers. Next they work with a partner to put sets of cards in order from least to greatest. The cards include both positive and negative rational numbers. Students then compare the locations of points on a horizontal number line using phrases, such as "greater than," "less than," "opposite," and "negative."

Student Learning Goal

Let's order rational numbers.

Access for Students with Diverse Abilities

- Representation (Warm-up)
- Engagement (Activity 1)

Access for Multilingual Learners

- MLR2: Collect and Display (Activity 1)

Instructional Routines

- Take Turns

Required Materials

Materials to Copy

- Ordering Rational Numbers Cards (1 copy for every 2 students): Activity 1

Required Preparation

Activity 1:
Copy each set of cards on a different color of paper so they can easily be sorted for the next class.

Lesson Timeline

Warm-up	Activity 1	Activity 2	Lesson Synthesis	Assessment: Cool-down
10 min	15 min	10 min	10 min	5 min

Warm-up

How Do They Compare?

10 min

Activity Narrative

The purpose of this *Warm-up* is for students to review strategies for using inequality symbols and comparing whole numbers, decimal numbers, and fractions. The numbers in each pair have been purposefully chosen based on misunderstandings students typically have when comparing numbers.

Launch

Give students 3 minutes of quiet work time, and follow with a whole-class discussion.

Student Task Statement

Use the symbols >, <, or = to compare each pair of numbers. Be prepared to explain your reasoning.

A. 12 < 19

Sample reasoning: 12 is farther left on the number line than 19.

B. 212 > 190

Sample reasoning: 212 is farther right on the number line than 190.

C. 15 > 1.5

Sample reasoning: 15 is 10 times farther to the right on the number line than 1.5

D. 9.02 < 9.2

Sample reasoning: Both numbers have 9 wholes, 9.2 has 2 tenths, and 9.02 doesn't have any.

E. 6.050 = 6.05

Sample reasoning: Both numbers have the same number of ones, tenths, hundredths, and thousandths.

F. 0.4 > $\frac{9}{40}$

Sample reasoning: 0.4 is greater than $\frac{1}{4}$, and $\frac{9}{40}$ is less than $\frac{1}{4}$.

G. $\frac{19}{24} < \frac{19}{21}$

Sample reasoning: Both fractions are the same number of pieces, and $\frac{1}{21}$ is greater than $\frac{1}{24}$.

H. $\frac{16}{17} > \frac{11}{12}$

Sample reasoning: Both fractions are 1 unit from a whole, and $\frac{1}{17}$ is less than $\frac{1}{12}$.

Activity Synthesis

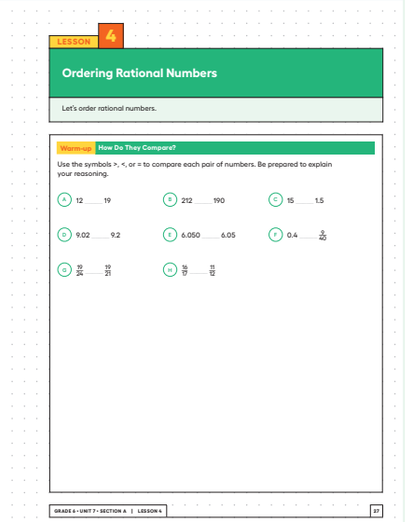
The goal of this discussion is to address any misconceptions the class has when comparing rational numbers. Begin by inviting 1–2 students to share their reasoning for each pair of numbers. Record and display their reasoning for all to see.

Access for Students with Diverse Abilities (Warm-up, Launch)

Representation: Develop Language and Symbols.
Provide students with access to definitions of the recently defined symbols for less than and greater than.

Supports accessibility for: Language, Memory

Student Workbook


LESSON 4

Ordering Rational Numbers

Let's order rational numbers.

Warm-up How Do They Compare?

Use the symbols >, <, or = to compare each pair of numbers. Be prepared to explain your reasoning.

A. 12 ___ 19 B. 212 ___ 190 C. 15 ___ 1.5

D. 9.02 ___ 9.2 E. 6.050 ___ 6.05 F. 0.4 ___ $\frac{9}{40}$

G. $\frac{19}{24}$ ___ $\frac{19}{21}$ H. $\frac{16}{17}$ ___ $\frac{11}{12}$

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Instructional Routines

Take Turns

ilclass.com/r/10573524

Please log in to the site before using the QR code or URL.

Access for Multilingual Learners (Activity 1, Student Task)

MLR2: Collect and Display
Circulate to listen for and collect the language that students use as they order negative numbers. On a visible display, record words and phrases, such as "greater than," "less than," "to the right of" and "to the left of." Invite students to borrow language from the display as needed, and update it throughout the lesson.
Advances: Conversing, Reading

Access for Students with Diverse Abilities (Activity 1, Student Task)

Engagement: Develop Effort and Persistence.
Chunk this task into more manageable parts. Give students a subset of the cards to start with and introduce the remaining cards once students have completed their initial set of matches.

Supports accessibility for: Conceptual Processing, Organization, Memory

Building on Student Thinking

If some students place negative numbers in order of increasing absolute value on the left side of 0, consider asking:

"How did you determine the order of the numbers less than 0?"
"How would the numbers be ordered on a number line to the left of (or below) 0?"

Since there are many pairs of numbers to compare, it may not be possible to share all of the students' strategies for each pair. Consider sharing only one strategy for each pair if all of the students agree and more than one if there is a disagreement among the students.

Activity 1
Ordering Rational Number Cards

15 min

Activity Narrative

In this partner activity, students take turns ordering rational numbers from least to greatest. As students trade roles explaining their thinking and listening, they have opportunities to explain their reasoning and critique the reasoning of others.

Launch

Arrange students in groups of 2, and explain that they will be putting a set of cards in order from least to greatest. If time allows, choose a student as a partner, and demonstrate how to set up and do the activity. Otherwise, share these steps:

- Place the card with the value of 0 in front of both partners.
- One partner picks a card and places it so that the cards are in order from least to greatest, and explains their placement.
- The other partner listens and makes sure they agree with the placement and the reasoning.
- If they don't agree, the partners discuss until they come to an agreement.
- For the next card placement, the students swap roles.

Give students 5 minutes to order the first set of cards.

When a group finishes, check their ordering before giving them the second set of cards.

Give students another 5 minutes to order the second set of cards, and follow with a whole-class discussion.

Student Task Statement

Your teacher will give you a set of number cards. Take turns with your partner placing a card from the set in order from least to greatest.

1. For each placement that you make, explain your reasoning to your partner.
2. For each placement that your partner makes, listen carefully to their explanation. If you disagree, discuss your thinking, and work to reach an agreement.
3. Pause after the first set so your teacher can review your ordering.
4. Your teacher will give you a second set of cards to add in order with the first set.

$-23, -22\frac{1}{2}, -22, -10, -9, -8, -7.5, -7, -5\frac{1}{2}, -5, -3, -2.5,$
$-2, -\frac{9}{8}, -1, -\frac{1}{4}, 0, \frac{1}{4}, 1, \frac{9}{8}, 2, 2.5, \frac{8}{3}, 3, 4, 5, 5\frac{1}{2}, 6, 7, 7.5, 8, 9,$
$10, 11, 14, 15, 16, 17, 22\frac{1}{2}, 25, 29, 30, 53, 62, 78, 87, 99, 100$

Activity Synthesis

The purpose of this discussion is for students to share their strategies for comparing and ordering rational numbers. Here are some questions to consider:

- *"Which numbers did you place first? Why?"*
- *"Which numbers were hardest to place, and which were the least difficult?"*
- *"How does placing negative numbers compare to placing positive numbers?"*
- *"How did you use numbers you had already placed to reason about where to place new numbers?"*
- *"Describe any difficulties you experienced and how you resolved them."*

Activity 2

Comparing Points on a Line

10 min

Activity Narrative

In this activity, students refine their language to be more precise when they use terms, such as "greater than," "less than, "opposite," and "negative".

Launch

Arrange students in groups of 2.

Give students 5 minutes of quiet work time, and follow with a whole-class discussion.

Student Task Statement

The number line shows 4 points: M, N, P, and R.

Use each of the following phrases in a sentence describing or comparing the values of 2 of the points.

- greater than

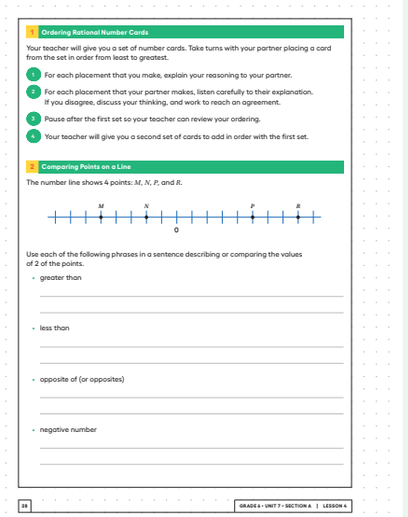
  Sample response: *R* is greater than *N*. *N* is greater than *M*.
- less than

  Sample response: *P* is less than *R*. *M* is less than *P*.
- opposite of (or opposites)

  Sample response: *M* is the opposite of *P*. *P* and *M* are opposites.
- negative number

  Sample response: *N* is a negative number. *M* is a negative number.

Student Workbook


2 Ordering Rational Number Cards

Your teacher will give you a set of number cards. Take turns with your partner placing a card from the set in order from least to greatest.

1. For each placement that you make, explain your reasoning to your partner.
2. For each placement that your partner makes, listen carefully to their explanation. If you disagree, discuss your thinking, and work to reach an agreement.
3. Pause after the first set so your teacher can review your ordering.
4. Your teacher will give you a second set of cards to add in order with the first set.

2 Comparing Points on a Line

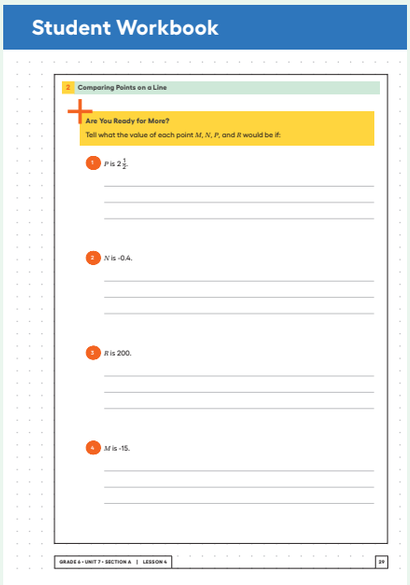
The number line shows 4 points: M, N, P, and R.

M N P R 0

Use each of the following phrases in a sentence describing or comparing the values of 2 of the points.

- greater than
- less than
- opposite of (or opposites)
- negative number

Student Workbook


2 Comparing Points on a Line

Are You Ready for More?

Tell what the value of each point M, N, P, and R would be if:

1. P is $2\frac{1}{2}$.
2. N is -0.4.
3. R is 200.
4. M is -15.

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Are You Ready for More?

Tell what the value of each point M, N, P, and R would be if:

1. P is $2\frac{1}{2}$.

   $M = -2\frac{1}{2}$, $N = -1$, $P = 2\frac{1}{2}$, $R = 4$.

2. N is -0.4.

   $M = -1$, $N = -0.4$, $P = 1$, $R = 1.6$.

3. R is 200.

   $M = -125$, $N = -50$, $P = 125$, $R = 200$.

4. M is -15.

   $M = -15$, $N = -6$, $P = 15$, $R = 24$.

Activity Synthesis

The goal of this discussion is to give students the opportunity to use precise language as they compare the relative positions of rational numbers.

Give students 2–3 minutes to discuss their responses with a partner before a whole-class discussion.

Ask students to share their partner's reasoning, especially if it was different than their own. Here are some questions to consider:

- *"Did you ever have a different answer than your partner? If so, were you both correct? If not, how did you work to reach an agreement?"*
- *"How can we tell if two numbers are opposites?"*

  They are the same distance from 0 but on opposite sides of 0.
- *"How can we tell if one number is greater or less than another number?"*

  Numbers toward the right are considered greater, and numbers toward the left are considered less.

Lesson Synthesis

The goal of this discussion is for students to summarize the ideas they have developed over the last few lessons. Here are some questions to consider: Consider recording and displaying student responses for all to see.

- *"What are some situations where negative numbers make sense? What do the words 'positive,' 'negative,' and '0' mean in those situations?"*

  Elevation: 0 represents sea level, negative represents below sea level, and positive represents above sea level. Temperature in degrees Celsius: 0 °C represents the standard freezing point of water, positive represents temperatures warmer than freezing, and negative represents temperatures below freezing.
- *"What do the words 'positive' and 'negative' mean on the number line? Is 0 positive or negative?"*

  Negative numbers are numbers left of (or below) 0 on the number line, and positive numbers are to the right of (or above) 0. The number 0 is neither positive nor negative.

"How can you tell if one number is greater than or less than another? How do you write it?"

Given two rational numbers, the number toward the right (or top) of the number line is considered "greater," and the number toward the left (or bottom) is considered "less." We use the < and > symbols to indicate "less than" and "greater than," respectively.

"What are some pairs of numbers that are opposites? What is the opposite of 0?"

Answers vary.

- 5 and -5
- 0.8 and -0.8
- $\frac{5}{6}$ and $-\frac{5}{6}$
- 0 is its own opposite

Lesson Summary

When ordering rational numbers from least to greatest, they can be listed in the order they appear on the number line from left to right. For example, we can see that the numbers

-2.7, -1.3, 0.8

are listed from least to greatest because of the order they appear on the number line.

On a horizontal number line, numbers to the left are smaller than numbers to the right. We can say that -2.7 is less than -1.3. We can write -2.7 < 1.3.

Similarly, numbers to the right are greater than numbers to the left. We can say that 0.8 is greater than -2.7. We can write 0.8 > -2.7.

Cool-down

Getting Them in Order

5 min

Student Task Statement

1. Place these numbers in order from least to greatest:

$\frac{16}{5}$ -3 6 3.1 -2.5 $\frac{1}{4}$ $-\frac{3}{4}$ $-\frac{3}{8}$

-3, -2.5, $-\frac{3}{4}$, $-\frac{3}{8}$, $\frac{1}{4}$, 3.1, $\frac{16}{5}$, 6

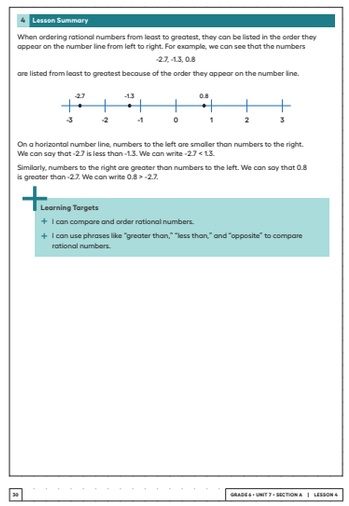
2. Write a sentence to compare the two points shown on the number line.

- -2.7 is less than 4.5
- 4.5 is greater than -2.7

Responding To Student Thinking

More Chances
Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

Student Workbook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-2.7 -1.3 0.8
-3 -2 -1 0 1 2 3

On a horizontal number line, numbers to the left are smaller than numbers to the right. We can say that -2.7 is less than -1.3. We can write -2.7 < 1.3.

Similarly, numbers to the right are greater than numbers to the left. We can say that 0.8 is greater than -2.7. We can write 0.8 > -2.7.

Learning Targets
+ I can compare and order rational numbers.
+ I can use phrases like "greater than," "less than," and "opposite" to compare rational numbers.

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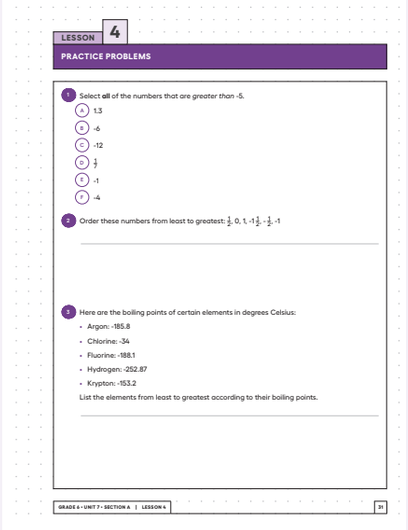
Lesson 4

Practice Problems

7 Problems

Student Workbook



LESSON 4

PRACTICE PROBLEMS

1. Select **all** of the numbers that are *greater than* -5.
   - A. 1.3
   - B. -6
   - C. -12
   - D. $\frac{1}{7}$
   - E. -1
   - F. -4
2. Order these numbers from least to greatest: $\frac{1}{2}$, 0, 1, $-1\frac{1}{2}$, $-\frac{1}{2}$, -1
3. Here are the boiling points of certain elements in degrees Celsius:
   - Argon: -185.8
   - Chlorine: -34
   - Fluorine: -188.1
   - Hydrogen: -252.87
   - Krypton: -153.2

   List the elements from least to greatest according to their boiling points.

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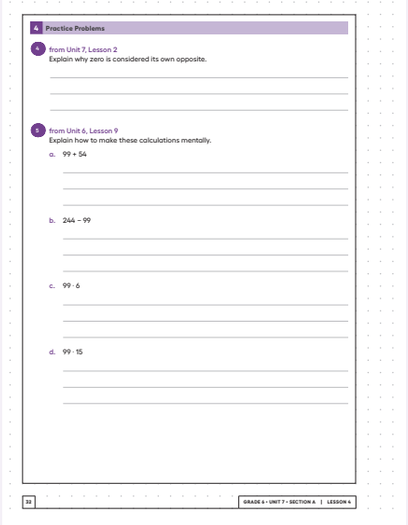
Student Workbook



4 Practice Problems

1. from Unit 7, Lesson 2
   Explain why zero is considered its own opposite.
2. from Unit 6, Lesson 9
   Explain how to make these calculations mentally.
   a. 99 + 54
   b. 244 − 99
   c. 99 · 6
   d. 99 · 15

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Problem 1

Select **all** of the numbers that are *greater than* -5.

A. 1.3

B. -6

C. -12

D. $\frac{1}{7}$

E. -1

F. -4

Problem 2

Order these numbers from least to greatest: $\frac{1}{2}$, 0, 1, $-1\frac{1}{2}$, $-\frac{1}{2}$, -1

$-1\frac{1}{2}$, -1, $-\frac{1}{2}$, 0, $\frac{1}{2}$, 1

Problem 3

Here are the boiling points of certain elements in degrees Celsius:

- Argon: -185.8
- Chlorine: -34
- Fluorine: -188.1
- Hydrogen: -252.87
- Krypton: -153.2

List the elements from least to greatest according to their boiling points.

Hydrogen, fluorine, argon, krypton, chlorine

Problem 4

from Unit 7, Lesson 2

Explain why zero is considered its own opposite.

Sample response: Opposites are equally distant from 0. Since 0 is the only number that is 0 units from 0, it has to be its own opposite. 0 + 0 = 0.

Problem 5

from Unit 6, Lesson 9

Explain how to make these calculations mentally.

a. 99 + 54

153

Sample responses: this is one less than 100 + 54 = 154.

b. 244 – 99

145

Sample response: this is one more than 244 – 100 = 144.

c. 99 · 6

594

Sample response: this is 1 six short of 100 sixes, or 600.

d. 99 · 15

1,485

Sample response: this is 1 fifteen short of 100 fifteens, or 1,500.

Problem 6

from Unit 4, Lesson 11

Find the quotients.

a. $\frac{1}{2} \div 2$

$\frac{1}{4}$

b. $2 \div 2$

1

c. $\frac{1}{2} \div \frac{1}{2}$

1

d. $\frac{38}{79} \div \frac{38}{79}$

1

Problem 7

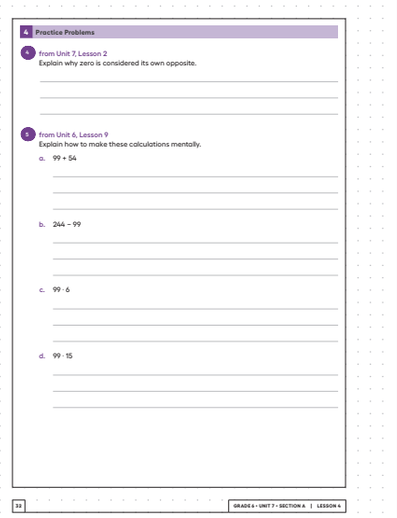
from Unit 3, Lesson 3

Over several months, the weight of a baby measured in pounds doubles. Does its weight measured in kilograms also double? Explain or show your reasoning.

Yes

Sample reasoning: The weight itself doubles, so any measurement of the weight using the same units will also double. We can also see that by saying if the weight is x pounds, then double that weight would be $2x$ pounds. The weight in kilograms will be $x \div 2.2$, and the double weight will be $(2x) \div 2.2$ or $2(x \div 2.2)$.

Student Workbook


4 Practice Problems

4 from Unit 7, Lesson 2
Explain why zero is considered its own opposite.

5 from Unit 6, Lesson 9
Explain how to make these calculations mentally.
a. 99 + 54
b. 244 – 99
c. 99 · 6
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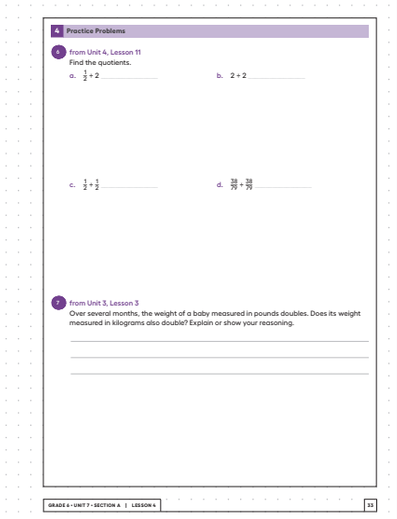
Student Workbook


4 Practice Problems

6 from Unit 4, Lesson 11
Find the quotients.
a. $\frac{1}{2} \div 2$
b. $2 \div 2$
c. $\frac{1}{2} \div \frac{1}{2}$
d. $\frac{38}{79} \div \frac{38}{79}$

7 from Unit 3, Lesson 3
Over several months, the weight of a baby measured in pounds doubles. Does its weight measured in kilograms also double? Explain or show your reasoning.

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