Lesson 7

One Hundred Percent

Goals

- Critique (orally and in writing) double number line diagrams that represent situations involving percent increase or decrease.
- Generalize (orally) that the original amount corresponds to 100% and the new amount corresponds to more or less than 100%, depending on whether the situation involves an increase or decrease.
- Interpret a description of a situation to identify the original amount, the new amount, the change, and corresponding percentages. Label these on a double number line diagram.

Learning Targets

- I can use a double number line diagram to help me solve percent increase and decrease problems.
- I understand that if I know how much a quantity has grown, then the original amount represents 100%.
- When I know the new amount and the percentage of increase or decrease, I can find the original amount.

Access for Students with Diverse Abilities

- Action and Expression (Activity 1)
- Representation (Activity 2)

Access for Multilingual Learners

- MLR3: Critique, Correct, Clarify (Activity 1)
- MLR6: Three Reads (Activity 2)

Instructional Routines

- MLR3: Critique, Correct, Clarify
- MLR6: Three Reads
- Which Three Go Together?

Lesson Narrative

In this lesson, students solve more problems about percent increase and decrease, including problems in which:

- They are given the final amount and the percentage, and they must calculate the original amount.
- They are given the original and final amounts, and they must calculate the percentage.

Lesson Timeline

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

Assessment: Cool-down

Lesson Narrative (continued)

Students use double number line diagrams to visualize the situations and make sense of which values they were given and what they are trying to find. They see that the starting amount always corresponds to 100%, regardless of whether the situation is an increase or a decrease and regardless of which amount is unknown.

As students explain how to represent situations with double number line diagrams, they construct arguments and critique the reasoning of others.

Student Learning Goal

Let's solve more problems about percent increase and percent decrease.

Warm-up

Which Three Go Together: Representing Percentages

5 min

Activity Narrative

This *Warm-up* prompts students to compare four diagrams that represent percent increase or percent decrease. It gives students a reason to use language precisely. It gives the teacher an opportunity to hear how students use terminology and talk about characteristics of the diagrams in comparison to one another.

Launch

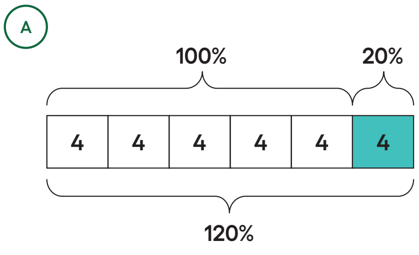
Arrange students in groups of 2–4. Display the diagrams for all to see.

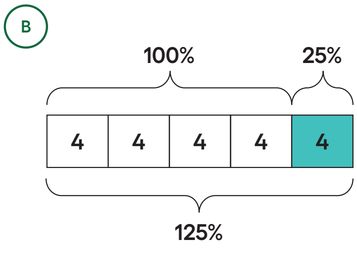
Give students 1 minute of quiet think time, and ask them to indicate when they have noticed three diagrams that go together and can explain why.

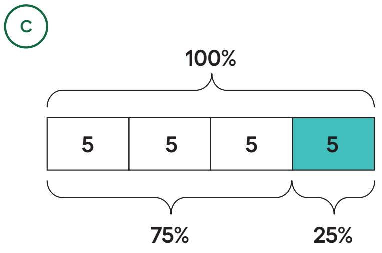
Next, tell students to share their response with their group and then together find as many sets of three as they can.

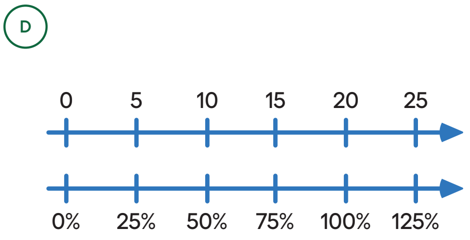
Student Task Statement

Which three go together? Why do they go together?









Sample responses:

A, B, and C go together because:

- They are tape diagrams.

A, B, and D go together because:

- They represent a percent increase.
- They show a percentage that is greater than 100%

A, C, and D go together because:

- The value 20 is 100%.

B, C, and D go together because:

- They are counting in increments of 25%.

Instructional Routines

Which Three Go Together?

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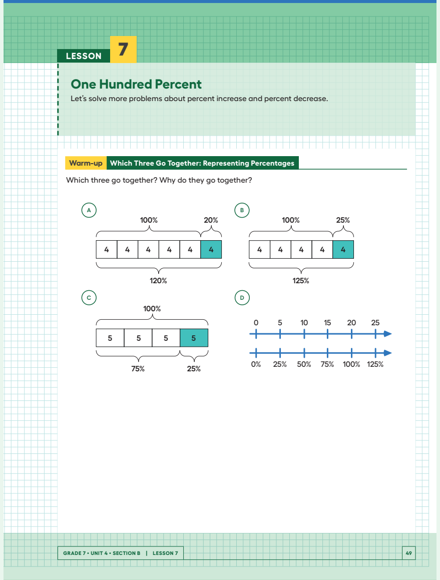
Student Workbook



LESSON 7

One Hundred Percent

Let's solve more problems about percent increase and percent decrease.

Warm-up Which Three Go Together: Representing Percentages

Which three go together? Why do they go together?

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Instructional Routines

MLR3: Critique, Correct, Clarify

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Access for Multilingual Learners (Activity 1)

MLR3: Critique, Correct, Clarify

This activity uses the *Critique, Correct, Clarify* math language routine to advance representing and conversing as students critique and revise mathematical arguments.

Building on Student Thinking

Students may continue to struggle to recognize the original amount and new amount with the proper percentages on the double number line. Remind them that the original amount always corresponds to 100%.

Activity Synthesis

Invite each group to share one reason why a particular set of three go together. Record and display the responses for all to see. After each response, ask the class if they agree or disagree. Since there is no single correct answer to the question of which three go together, attend to students' explanations, and ensure the reasons given are correct.

During the discussion, prompt students to explain the meaning of any terminology they use, such as "original amount," "new amount," "increase," and "decrease," and to clarify their reasoning as needed. Consider asking:

"How do you know … ?"

"What do you mean by … ?"

"Can you say that in another way?"

If not mentioned by students, ask them to discuss the amount that corresponds to 100% for each diagram.

Activity 1

Double Number Lines

15 min

Activity Narrative

In this activity, students complete double number line diagrams that represent situations involving percent increase and percent decrease. For each situation, two values are given. Students interpret the situation to determine where to label the given values on the double number line diagram. Then students can use the diagram to find the unknown, third value, whether it is the new amount, the original amount, or the percentage of the increase or decrease. The goal is to reinforce that the original amount pertains to 100%.

In this activity, students critique a statement or response that is intentionally unclear, incorrect, or incomplete and improve it by clarifying meaning, correcting errors, and adding details.

Launch

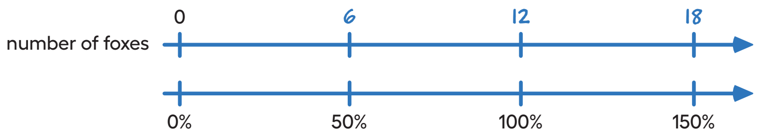
Arrange students in groups of 2.

Give 5–8 minutes of partner work time.

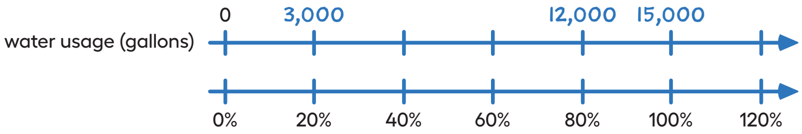
Student Task Statement

For each problem, complete the double number line diagram to show the percentages that correspond to the original amount and to the new amount.

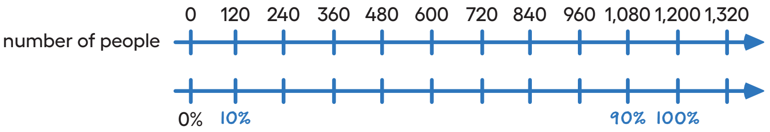
1. Last year, scientists counted 12 foxes in a conservation area. This year, they counted 50% more than that. How many foxes did they count this year? 18 foxes



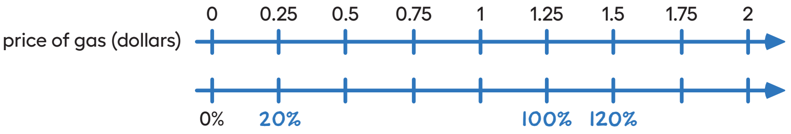
2. After replacing some grass with rocks, a business decreased its water usage by 20%. If their old water usage was 15,000 gallons per week, how much do they use now? 12,000 gallons



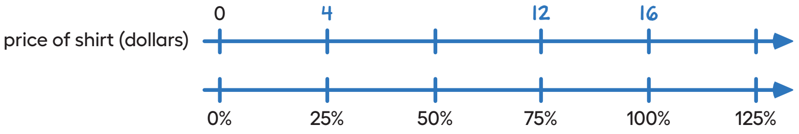
3. A school had 1,200 students last year and only 1,080 students this year. What was the percent decrease in the number of students? 10% decrease



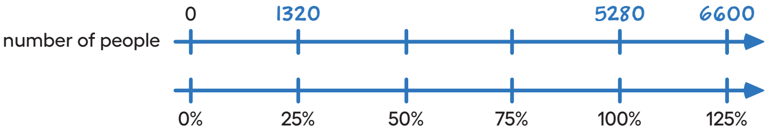
4. One week, gas was $1.25 per gallon. The next week, gas was $1.50 per gallon. By what percentage did the price increase? 20% increase



5. After a 25% discount, the price of a T-shirt was $12. What was the price before the discount? $16



6. Compared to last year, the population of Boom Town has increased 25%. The population is now 6,600. What was the population last year? 5,280 people



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

Action and Expression: Internalize Executive Functions.

To support development of organizational skills in problem-solving, chunk this task into more manageable parts. For example, present one question at a time, and monitor students to ensure they are making progress throughout the activity.

Supports accessibility for: Organization, Attention

Student Workbook

1 **Double Number Lines**

For each problem, complete the double number line diagram to show the percentages that correspond to the original amount and to the new amount.

① Last year, scientists counted 12 foxes in a conservation area. This year, they counted 50% more than that. How many foxes did they count this year?

② After replacing some grass with rocks, a business decreased its water usage by 20%. If their old water usage was 15,000 gallons per week, how much do they use now?

③ A school had 1,200 students last year and only 1,080 students this year. What was the percent decrease in the number of students?

④ One week, gas was $1.25 per gallon. The next week, gas was $1.50 per gallon. By what percentage did the price increase?

50

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Student Workbook

1 Double Number Lines

5 After a 25% discount, the price of a T-shirt was $12. What was the price before the discount?

6 Compared to last year, the population of Boom Town has increased 25%. The population is now 6,600. What was the population last year?

Are You Ready for More?

Employee A gets a pay raise of 10%. Employee B gets a pay raise of 6%.

Kiran says, “That means Employee A got the bigger pay raise.” Do you agree or disagree with this statement? Explain your reasoning.

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Are You Ready for More?

Employee A gets a pay raise of 10%. Employee B gets a pay raise of 6%.

Kiran says, “That means Employee A got the bigger pay raise.”

Do you agree or disagree with this statement? Explain your reasoning.

Sample response: It depends on what each employee was making before the raise. If both employees were making the same amount of money before the raise, then Employee A gets the bigger pay raise. However, if Employee A was making less than Employee B, then 10% of A’s previous pay might not be bigger than 6% of B’s previous pay. Each raise is stated as a percentage of that individual employee’s previous pay.

Activity Synthesis

Invite students to share the values they identified as the original amount and the new amount for a few problems. Discuss how 100% always corresponds to the original value and when there is an increase in the value, the new value corresponds to a percentage greater than the original 100%.

Use *Critique, Correct, Clarify* to give students an opportunity to improve a sample written response to the last question, about the population of Boom Town, by correcting errors, clarifying meaning, and adding details.

- Display this first draft:

“Since the population has increased by 25%, that means last year’s population was 75% of this year’s population. $0.75 \cdot 6{,}600 = 4, 950$, so last year’s population was 4,950 people.”

Ask,

“What parts of this response are unclear, incorrect, or incomplete?” ***As students respond, annotate the display with 2–3 ideas to indicate the parts of the writing that could use improvement.***

Give students 2–4 minutes to work with a partner to revise the first draft.

- Select 1–2 individuals or groups to read their revised draft aloud slowly enough to record for all to see. Scribe as each student shares, then invite the whole class to contribute additional language and edits to make the final draft even more clear and more convincing.

Activity 2

Protecting the Green Sea Turtle

10 min

Activity Narrative

In this activity students interpret situations involving percent increase or percent decrease to determine whether they need to find the new amount or the original amount. No diagrams are given, so students may decide to create a tape diagram or double number line diagram to represent each situation. As students choose a solution strategy such as drawing a diagram, they are making sense of problems and persevering in solving them.

The first problem involves finding the new amount after a 10% increase. The second problem involves finding the original amount before a 10% decrease. By the end of this activity, students should come to see why these two situations call for different solution methods.

Launch

Use *Three Reads* to support reading comprehension and sense-making about this problem. Display only the problem stem and description of each beach, without revealing the questions.

- For the first read, read the problem aloud, then ask,

"What is this situation about?"

the number of sea turtles on a beach

Listen for and clarify any questions about the context.

- After the second read, ask students to list any quantities that can be counted or measured.

this year's number of turtles; last year's number of turtles; the percentage of the increase or decrease

- After the third read, reveal the two questions: "How many turtles came ashore to lay eggs in the sanctuary this year?" and "How many nesting turtles were at this sanctuary last year?" and ask,

"What are some ways we might get started on this?"

Invite students to name some possible starting points, referencing quantities from the second read.

creating a tape diagram or double number line diagram; identifying the amount in each situation that corresponds to 100%

Give students 4–5 minutes of quiet work time followed by time for partner discussion.

Then hold a whole-class discussion.

Student Task Statement

Green sea turtles live most of their lives in the ocean, but they come ashore to lay their eggs. Some beaches where turtles often come ashore have been made into protected sanctuaries so that the eggs will not be disturbed.

1. One sanctuary had 180 green sea turtles come ashore to lay eggs last year. This year, the number of turtles increased by 10%. How many turtles came ashore to lay eggs in the sanctuary this year?

   198 turtles

2. At another sanctuary, the number of nesting turtles decreased by 10% between last year and this year. This year there were 234 nesting turtles. How many nesting turtles were at this sanctuary last year?

   260 turtles

Instructional Routines

MLR6: Three Reads

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Access for Multilingual Learners (Activity 2)

MLR6: Three Reads

This activity uses the *Three Reads* math language routine to advance reading and representing as students make sense of what is happening in the text.

Access for Students with Diverse Abilities (Activity 2, Launch)

Representation: Internalize Comprehension.

Represent the same information through different modalities by using a double number line diagram to help organize the information provided.

Supports accessibility for: Conceptual Processing, Visual-Spatial Processing

Building on Student Thinking

For the percent decrease problem, students may calculate 10% of 234, getting a change of 23.4 turtles and an original number of 257.4 turtles. Remind them that the percent decrease describes the change as a percentage of the original value, not as a percentage of the new value. If needed, prompt students to use a double number line to represent the situation, placing 234 to the left by 10% of the quantity they want to find, which should be associated with 100%.

Activity Synthesis

The purpose of this discussion is to highlight why the solution processes are not the same for the two problems:

1. Finding the new amount after a 10% increase
2. Finding the original amount before a 10% decrease

The key point to remember is that 100% corresponds to the original amount.

Invite students to share how they reasoned about each problem. To help students make comparisons between the two problems, consider asking:

💬 *"How are the two problems the same? How are they different?"*

They both involve a change of 10%. The first situation is an increase, while the second situation is a decrease.

💬 *"What information is given in the first problem that is not given in the second? And in the second that is not in the first?"*

The first problem gave the original amount. The second problem gave the new amount.

💬 *"In which problem were you given the quantity that represented 100%?"*

the first problem

💬 *"For the second situation, the given number 234 represents what percentage of the original amount? How do you know?"*

90% It is the amount that was left after a 10% decrease.

💬 *"How can you use that percentage to figure out the original number of green sea turtles?"*

by finding the value that is 100% for which 234 is 90%

Lesson Synthesis

Share with students,

💬 *"Today we used double number line diagrams to make sense of situations involving percent increase or percent decrease."*

To review the different types of problems that students solved, consider asking:

💬 *"What part of the situation is always 100%?"*

the starting amount

💬 *"If there was a 30% increase, where would you put the new amount on the double number line?"*

at 130%

💬 *"Where would you put the original amount?"*

at 100%

💬 *"If there was a 30% decrease, where would you put the new amount on the double number line?"*

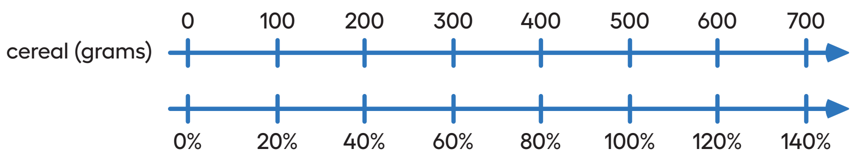
at 70%

💬 *"Where would you put the original amount?"*

still at 100%

Lesson Summary

We can use a double number line diagram to show information about percent increase and percent decrease:



The initial amount of cereal is 500 grams, which is lined up with 100% in the diagram. We can find a 20% *increase* by adding 20% of 500:

$$\begin{aligned} 500 + (0.2) \cdot 500 &= (1.20) \cdot 500 \\ &= 600 \end{aligned}$$

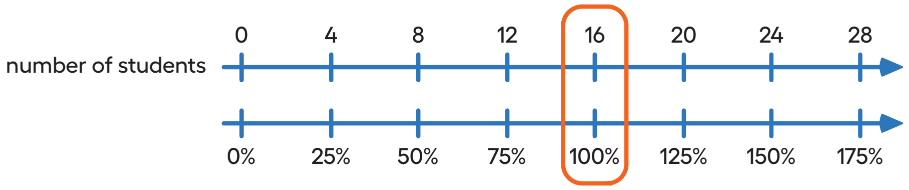
In the diagram, we can see that 600 corresponds to 120%.

If the initial amount of 500 grams is *decreased* by 40%, we can find how much cereal there is by subtracting 40% of the 500 grams:

$$\begin{aligned} 500 - (0.4) \cdot 500 &= (0.6) \cdot 500 \\ &= 300 \end{aligned}$$

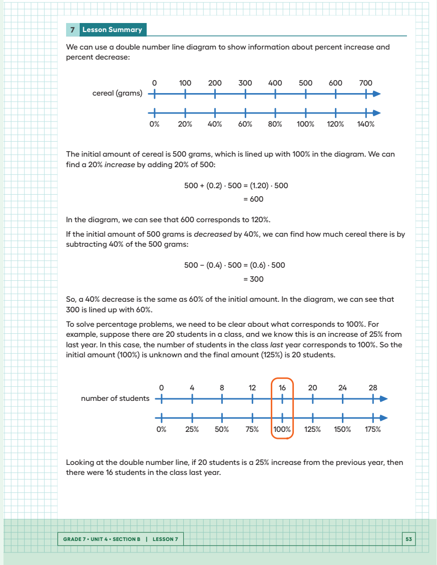
So, a 40% decrease is the same as 60% of the initial amount. In the diagram, we can see that 300 is lined up with 60%.

To solve percentage problems, we need to be clear about what corresponds to 100%. For example, suppose there are 20 students in a class, and we know this is an increase of 25% from last year. In this case, the number of students in the class *last* year corresponds to 100%. So the initial amount (100%) is unknown and the final amount (125%) is 20 students.



Looking at the double number line, if 20 students is a 25% increase from the previous year, then there were 16 students in the class last year.

Student Workbook



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.

Cool-down

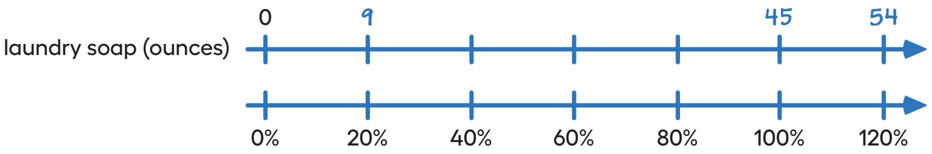
More Laundry Soap

5 min

Student Task Statement

A company claims that their new box holds 20% more laundry soap. If the new box holds 54 ounces of soap, how much did the old box hold?

Explain or show your reasoning. If you get stuck, consider using the double number line.



45 ounces

Sample reasoning: After a 20% increase, the new value is 120% of the original.

Lesson 7

Practice Problems

6 Problems

Problem 1

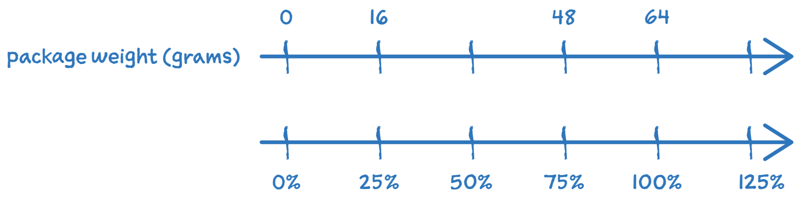
A bakery used 25% more butter this month than last month. If the bakery used 240 kilograms of butter last month, how much did it use this month?

300 kilograms

Problem 2

A company has decreased the amount of plastic packaging on their product by 25%. If the packaging now weighs 48 grams, what did it weigh before the change?

64 grams



Problem 3

Noah thinks the answers to these two questions will be the same. Do you agree with him? Explain your reasoning.

- This year, a herd of bison had a 10% increase in population. If there were 550 bison in the herd last year, how many are in the herd this year?
- This year, another herd of bison had a 10% decrease in population. If there are 550 bison in the herd this year, how many bison were there last year?

No, the answers are different. Although the answer to each problem is larger than 550, the number of bison in each 10% change is different because the original values are not the same.

Problem 4

from Unit 4, Lesson 5

Elena walked 12 miles. Then she walked 0.25 that distance. How far did she walk all together? Select **all** that apply.

[✓ **A.** 12 + 0.25 · 12]

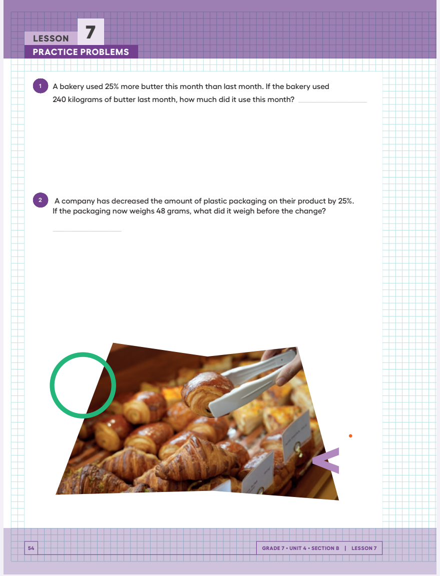
[✓ **B.** 12(1 + 0.25)]

[✓ **C.** 12 · 1.25]

D. 12 · 0.25

E. 12 + 0.25

Student Workbook



LESSON 7
PRACTICE PROBLEMS

① A bakery used 25% more butter this month than last month. If the bakery used 240 kilograms of butter last month, how much did it use this month? ______

② A company has decreased the amount of plastic packaging on their product by 25%. If the packaging now weighs 48 grams, what did it weigh before the change?

______

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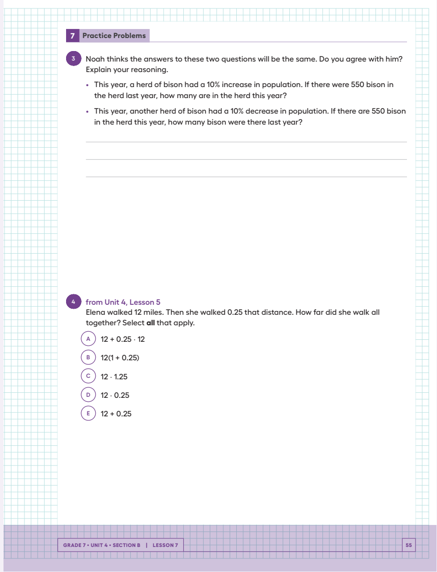
Student Workbook



7 Practice Problems

③ Noah thinks the answers to these two questions will be the same. Do you agree with him? Explain your reasoning.

- This year, a herd of bison had a 10% increase in population. If there were 550 bison in the herd last year, how many are in the herd this year?
- This year, another herd of bison had a 10% decrease in population. If there are 550 bison in the herd this year, how many bison were there last year?

④ from Unit 4, Lesson 5
Elena walked 12 miles. Then she walked 0.25 that distance. How far did she walk all together? Select **all** that apply.

Ⓐ 12 + 0.25 · 12
Ⓑ 12(1 + 0.25)
Ⓒ 12 · 1.25
Ⓓ 12 · 0.25
Ⓔ 12 + 0.25

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Student Workbook

7 Practice Problems

5 from Unit 3, Lesson 8

A circle's circumference is 600 m. What is a good approximation of the circle's area?

Ⓐ 300 m^2

Ⓑ 3,000 m^2

Ⓒ 30,000 m^2

Ⓓ 300,000 m^2

6 from Unit 2, Lesson 6

The equation $d = 3t$ represents the relationship between the distance (d) in inches that a snail is from a certain rock and the time (t) in minutes.

a. What does the number 3 represent?

b. How many minutes does it take the snail to get 9 inches from the rock?

c. How far will the snail be from the rock after 9 minutes?

Learning Targets

- I can use a double number line diagram to help me solve percent increase and decrease problems.
- I understand that if I know how much a quantity has grown, then the original amount represents 100%.
- When I know the new amount and the percentage of increase or decrease, I can find the original amount.

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Problem 5

from Unit 3, Lesson 8

A circle's circumference is 600 m. What is a good approximation of the circle's area?

A. 300 m^2

B. 3,000 m^2

[✓ **C.** 30,000 m^2]

D. 300,000 m^2

Problem 6

from Unit 2, Lesson 6

The equation $d = 3t$ represents the relationship between the distance (d) in inches that a snail is from a certain rock and the time (t) in minutes.

a. What does the number 3 represent?

the constant of proportionality or the speed of the snail, 3 inches per minute

b. How many minutes does it take the snail to get 9 inches from the rock?

3 minutes

c. How far will the snail be from the rock after 9 minutes?

27 inches