Lesson 4

Practice Solving Equations

Goals

- Explain and critique (orally and in writing) strategies for solving equations.
- Solve equations of the form $x + p = q$ or $px = q$ and explain (in writing) the solution method.

Learning Target

I can solve addition and multiplication equations with one variable.

Lesson Narrative

In this lesson, students consolidate their equation solving skills. In the first activity, they use partially solved equations to identify solutions. In the second activity, students match equations to their solutions found algebraically. Students then study groups of solved equations and generalize about a solution method by noticing regularity through repeated reasoning.

In the last activity, students solve a variety of equations that look different but still share the same two basic structures: $x + p = q$ or $px = q$. Students may choose any strategy to solve the equations, including drawing diagrams to reason about unknown quantities, looking at the structure of the equation, or doing the same thing to each side of the equation. Students choose strategies for specific problems. This will help students develop flexibility and fluency in writing and solving equations.

Student Learning Goal

Let's solve equations by doing the same to each side.

Access for Students with Diverse Abilities

- Action and Expression (Activity 2)
- Representation (Warm-up)

Access for Multilingual Learners

- MLR8: Discussion Supports (Warm-up, Activity 1)

Instructional Routines

- Card Sort
- Math Talk
- Take Turns

Required Materials

Materials to Copy

- Card Sort Equations and Solutions Cards (1 copy for every 2 students): Activity 1

Lesson Timeline

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

Warm-up

Math Talk: Dividing by Fifths

5 min

Activity Narrative

This *Math Talk* focuses on division of a number by a fraction. It encourages students to reason about the meaning of division and to rely on their knowledge of the division algorithm or what they know about the relationship between the dividend, divisor, and quotient to mentally solve problems. The understanding elicited here will be helpful later in the lesson when students solve equations of the form $px = q$ where p and q are fractions.

In explaining their strategies, students need to be precise in their word choice and use of language.

Launch

Tell students to close their books or devices (or to keep them closed). Reveal one problem at a time. For each problem:

- Give students quiet think time, and ask them to give a signal when they have an answer and a strategy.
- Invite students to share their strategies, and record and display their responses for all to see.
- Use the questions in the *Activity Synthesis* to involve more students in the conversation before moving to the next problem.

Keep all previous problems and work displayed throughout the talk.

Student Task Statement

Find the value of each expression.

A. $10 \div \frac{1}{5}$

50

Sample reasoning:

- There are 5 groups of $\frac{1}{5}$ in 1, so there are 10 · 5 groups in 10.
- $50 \cdot \frac{1}{5} = \frac{50}{5} = 10$

B. $10 \div \frac{2}{5}$

25

Sample reasoning:

- There are half as many groups of $\frac{2}{5}$ in 10 as there are groups of $\frac{1}{5}$, and half of 50 is 25.
- Ten is $\frac{50}{5}$, and there are 25 groups of $\frac{2}{5}$ in $\frac{50}{5}$.

C. $1 \div \frac{2}{5}$

2.5

Sample reasoning:

- The dividend 1 is one tenth of the dividend in the second problem while the divisor is the same, so the quotient is one tenth of 25, which is 2.5.
- There are 2 full groups plus $\frac{1}{2}$ group of $\frac{2}{5}$ in 1.

Instructional Routines

Math Talk

ilclass.com/r/10694967

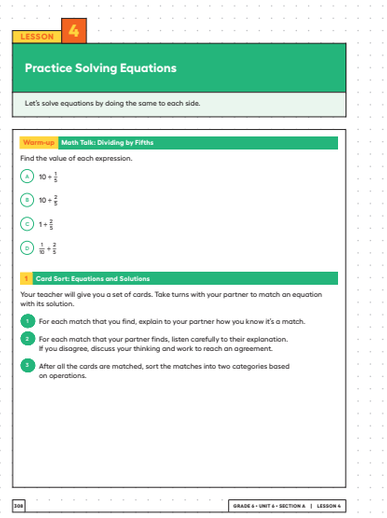
Please log in to the site before using the QR code or URL.

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

Representation: Internalize Comprehension.
To support working memory, provide students with sticky notes or mini whiteboards.

Supports accessibility for: Memory; Organization

Student Workbook


LESSON 4

Practice Solving Equations

Let's solve equations by doing the same to each side.

Warm-up Math Talk: Dividing by Fifths

Find the value of each expression.

A $10 \div \frac{1}{5}$

B $10 \div \frac{2}{5}$

C $1 \div \frac{2}{5}$

D $\frac{1}{10} \div \frac{2}{5}$

1 Card Sort: Equations and Solutions

Your teacher will give you a set of cards. Take turns with your partner to match an equation with its solution.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.
3. After all the cards are matched, sort the matches into two categories based on operations.

Access for Multilingual Learners (Warm-up, Synthesis)

MLR8: Discussion Supports
Display sentence frames to support students when they explain their strategy. For example, "First, I _____ because ..." or "I noticed _____ so I ..." Some students may benefit from the opportunity to rehearse what they will say with a partner before they share with the whole class.

Advances: Speaking, Representing

Instructional Routines

Card Sort

ilclass.com/r/10783726

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Instructional Routines

Take Turns

ilclass.com/r/10573524

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Access for Multilingual Learners (Activity 1, Launch)

MLR8: Discussion Supports
Students should take turns finding a match and explaining their reasoning to their partner. Display the following sentence frame for all to see: "I noticed _____, so I matched ..." When students disagree, encourage them to challenge each other using these sentence frames: "I agree because ..." and "I disagree because ..." This will help students clarify their reasoning about how the equations match the solutions."

Advances: Conversing

D. $\frac{1}{10} \div \frac{2}{5}$

0.25

Sample reasoning:

- The dividend $\frac{1}{10}$ is one tenth of the dividend in the previous problem, so the quotient is one tenth of 2.5, which is 0.25.
- $\frac{2}{5}$ is $\frac{4}{10}$, which means there is $\frac{1}{4}$ of $\frac{4}{10}$ in $\frac{1}{10}$.
- $\frac{1}{10} \div \frac{2}{5} = \frac{1}{10} \cdot \frac{5}{2}$, which is $\frac{5}{20}$ or $\frac{1}{4}$.

Activity Synthesis

Ask students to share their strategies for each problem. Record and display their responses for all to see. To involve more students in the conversation, consider asking:

- *"Who can restate _____'s reasoning in a different way?"*
- *"Did anyone use the same strategy but would explain it differently?"*
- *"Did anyone solve the problem in a different way?"*
- *"Does anyone want to add on to _____'s strategy?"*
- *"Do you agree or disagree? Why?"*

Activity 1

Card Sort: Equations and Solutions

15 min

Activity Narrative

In this partner activity, students take turns finding equations and their solutions. As students trade roles explaining their thinking and listening, they have opportunities to explain their reasoning and critique the reasoning of others.

After sorting all the matches into two categories, students use observations about mathematical structure in the equations and solutions to generalize an algebraic solving strategy for equations of the form $x + p = q$ or $px = q$.

Launch

Tell students that the cards contain either an equation or a solution, and that they will take turns matching the cards. Explain how to set up and do the activity. If time allows, demonstrate these steps with a student as a partner:

- Mix up the cards and place them faceup.
- One person selects one card of each type and explains to their partner why the cards match.
- The partner's job is to listen to the speaker's reasoning and make sure it makes sense. If there is a disagreement, the partners discuss until coming to an agreement.
- When both partners agree on the match, they switch roles.

Consider demonstrating productive ways to agree or disagree, for example, by explaining your mathematical thinking or asking clarifying questions.

Arrange students in groups of 2. Give each group a set of 16 cards cut from the blackline master.

Student Task Statement

Your teacher will give you a set of cards. Take turns with your partner to match an equation with its solution.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.
3. After all the cards are matched, sort the matches into two categories based on operations.

Addition equation matches: E and M, F and I, G and O, H and P

Multiplication equation matches: A and L, B and J, C and N, D and K

Activity Synthesis

Ask students to study the group of equations that use addition.

- *"How are these equations alike?"*

  They all start with a variable x and add another number. The total is on the other side of the equal sign. The variable x plus a number equals a number.

- *"How are all of these equations solved?"*

  The number that is added to the variable is subtracted from both sides.

Ask students to study the group of equations that use multiplication.

- *"How are these equations alike?"*

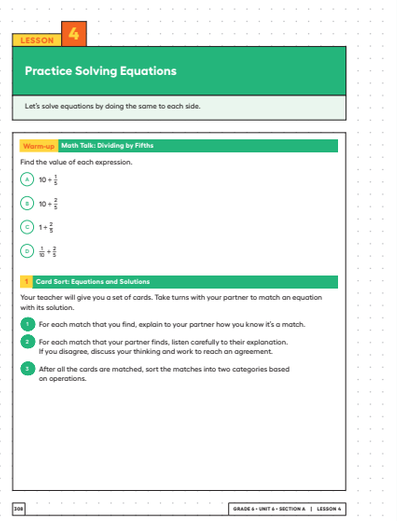
  They all have a coefficient and a variable on one side of the equal sign and the total on the other. The variable x multiplied by a number equals a number.

- *"How are all of these equations solved?"*

  Both sides of the equation are divided by the number that the variable is multiplied by.

Point out that the equations show that these solving strategies work when p and q are whole numbers, fractions, or decimals.

Student Workbook


LESSON 4

Practice Solving Equations

Let's solve equations by doing the same to each side.

Warm-up: Math Talk: Dividing by Fifths

Find the value of each expression.

A. $10 \div \frac{1}{5}$

B. $10 \div \frac{2}{5}$

C. $1 \div \frac{2}{5}$

D. $\frac{1}{10} \div \frac{2}{5}$

1 Card Sort: Equations and Solutions

Your teacher will give you a set of cards. Take turns with your partner to match an equation with its solution.

1. For each match that you find, explain to your partner how you know it's a match.
2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.
3. After all the cards are matched, sort the matches into two categories based on operations.

Activity 2

Row Game: Solving Equations Practice

15 min

Activity Narrative

The purpose of this activity is for students to practice solving equations. Some students may use the "do the same to each side" strategy they developed in their work with balanced hanger diagrams and formalized in the previous activity. Others may use strategies like substituting values until they find a value that makes the equation true, or asking themselves questions like "2 times what is 18?" As students progress through the activity, the equations become more difficult to solve by strategies other than "do the same thing to each side."

Launch

Display an equation like $2x = 12$. Ask,

- *"What can we do to each side of this equation to find the solution?"*

  Divide both sides by 2.

Demonstrate how to record what is being done to the equation. Point out that we end up with a variable on one side of the equal sign and a number on the other: $x = 6$. Explain that this format makes it easy to read the solution (in this case 6), and we often write solutions in this way. Tell students that the act of finding an equation's solution is sometimes called *solving* the equation.

Arrange students in groups of 2, and ensure that everyone understands how the Row Game works before students start working.

Allow students 10 minutes of partner work followed by a whole-class discussion.

Monitor for students who use the following strategies and select them to share during the *Activity Synthesis*.

- Draw a diagram to represent the equation.
- Rephrase the equation as a question, such as "8 times what number is 56?"
- Substitute values for the variable until they find the value that makes the equation true.
- Do the same thing to both sides of the equation until the variable is alone on one side.

Student Task Statement

Solve the equations in one column. Your partner will work on the other column.

Check in with your partner after you finish each row. Your answers in each row should be the same. If your answers aren't the same, work together to find the error and correct it.

column A	column B
$18 = 2x$	$36 = 4x$
$17 = x + 9$	$13 = x + 5$
$8x = 56$	$3x = 21$
$21 = \frac{1}{4}x$	$28 = \frac{1}{3}x$
$6x = 45$	$8x = 60$
$x + 4\frac{5}{6} = 9$	$x + 3\frac{5}{6} = 8$
$\frac{5}{7}x = 55$	$\frac{3}{7}x = 33$
$\frac{1}{5} = 6x$	$\frac{1}{3} = 10x$
$2.17 + x = 5$	$6.17 + x = 9$
$\frac{20}{3} = \frac{10}{9}x$	$\frac{14}{5} = \frac{7}{15}x$
$14.88 + x = 17.05$	$3.91 + x = 6.08$
$3\frac{3}{4}x = 1\frac{1}{4}$	$\frac{7}{5}x = \frac{7}{15}$

Row 1. $x = 9$

Row 2. $x = 8$

Row 3. $x = 7$

Row 4. $x = 84$

Row 5. $x = 7\frac{1}{2}$

Row 6. $x = 4\frac{1}{6}$

Row 7. $x = 77$

Row 8. $x = \frac{1}{30}$

Row 9. $x = 2.83$

Row 10. $x = 6$

Row 11. $x = 2.17$

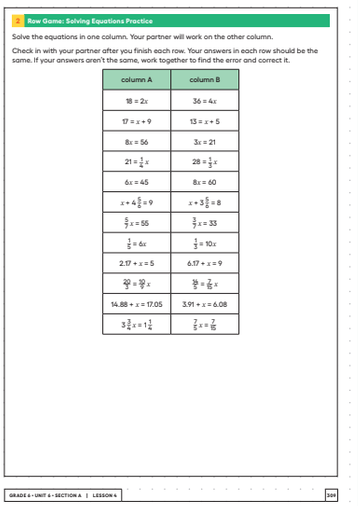
Row 12. $x = \frac{1}{3}$

Access for Students with Diverse Abilities (Activity 2, 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, after students have completed the first four rows of the table, check in with either select groups of students or the whole class. Invite students to share the strategies they have used so far as well as any questions they have before continuing.

Supports accessibility for: Organization, Attention

Student Workbook


2 Row Game: Solving Equations Practice

Solve the equations in one column. Your partner will work on the other column.

Check in with your partner after you finish each row. Your answers in each row should be the same. If your answers aren't the same, work together to find the error and correct it.

column A	column B
$18 = 2x$	$36 = 4x$
$17 = x + 9$	$13 = x + 5$
$8x = 56$	$3x = 21$
$21 = \frac{1}{4}x$	$28 = \frac{1}{3}x$
$6x = 45$	$8x = 60$
$x + 4\frac{5}{6} = 9$	$x + 3\frac{5}{6} = 8$
$\frac{5}{7}x = 55$	$\frac{3}{7}x = 33$
$\frac{1}{5} = 6x$	$\frac{1}{3} = 10x$
$2.17 + x = 5$	$6.17 + x = 9$
$\frac{20}{3} = \frac{10}{9}x$	$\frac{14}{5} = \frac{7}{15}x$
$14.88 + x = 17.05$	$3.91 + x = 6.08$
$3\frac{3}{4}x = 1\frac{1}{4}$	$\frac{7}{5}x = \frac{7}{15}$

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Activity Synthesis

Invite previously selected students to share how they used different strategies to solve the equations. Emphasize that no strategy is "better" than another. However, some strategies are more challenging to use when the equations involve fractions or decimals.

Display the equation $\frac{9}{5} = \frac{3}{10}x$.

"Which strategy would you use to solve this equation? Why?"

Divide both sides of the equation by $\frac{3}{10}$ because it would be difficult to draw a diagram for these fractions, and it would take too long to substitute values for the variable until one of the values makes the equation true.

Consider describing and annotating the steps involved in dividing each side of the equation by $\frac{3}{10}$. For example:

$$\frac{9}{5} = \frac{3}{10}x$$
$$\frac{9}{5} \div \frac{3}{10} = \frac{3}{10}x \div \frac{3}{10}$$
$$\frac{9}{5} \cdot \frac{10}{3} = x$$
$$\frac{90}{15} = x$$

Display the solution for the equation as $x = 6$.

"What does it mean that 6 is the solution to this equation?"

When the variable x is replaced with 6, the equation is true.

"How can we check that this solution is correct?"

Replace the variable x with 6 and see whether both sides of the equation have the same value.

Demonstrate using substitution to check the solution. Encourage students to use this method to check their solutions for equations.

Lesson Synthesis

The end of this lesson is a good place for students to take a moment and reflect on the learning of the past four lessons. Some questions to guide the discussion:

"What have you learned about equations and variables that surprised you?"

"What does it mean to solve an equation with a variable?"

"What are some strategies you can use to solve equations with a variable?"

"How can you check that a solution to an equation is correct?"

Lesson Summary

When we solve an equation with a variable, we find the value for the variable that makes the equation true. One way to solve the equation is to do the same thing to each side until the variable is alone on one side of the equal sign, and see what is on the other side.

Solve the equation $x + \frac{3}{4} = \frac{7}{8}$.

The fraction $\frac{3}{4}$ is added to the variable x.

$$x + \frac{3}{4} = \frac{7}{8}$$

So, we can subtract $\frac{3}{4}$ from each side of the equation.

$$x + \frac{3}{4} - \frac{3}{4} = \frac{7}{8} - \frac{3}{4}$$

The variable is alone on one side of the equal sign and on the other side.

$$x = \frac{1}{8}$$

When we substitute $\frac{1}{8}$ for x in the original equation, the equation is true. So, we know $\frac{1}{8}$ is the solution.

$$\frac{1}{8} + \frac{3}{4} = \frac{7}{8}$$
$$\frac{7}{8} = \frac{7}{8}$$

Solve the equation $3.5x = 31.5$.

The variable x is multiplied by 3.5.

$$3.5x = 31.5$$

So, we can divide each side of the equation by 3.5.

$$3.5x \div 3.5 = 31.5 \div 3.5$$

The variable is alone on one side of the equal sign, and 9 is on the other side.

$$x = 9$$

When we substitute 9 for x in the original equation, the equation is true. So, we know 9 is the solution.

$$3.5(9) = 31.5$$
$$31.5 = 31.5$$

Cool-down

Solve It!

5 min

Student Task Statement

Solve each equation. Explain or show your reasoning.

1. $x + 1\frac{3}{4} = 10$.

$x = 6\frac{1}{4}$

Sample reasoning: $x + 1\frac{3}{4} - 1\frac{3}{4} = 8 - 1\frac{3}{4}$

2. $5.7x = 17.1$

$x = 3$

Sample reasoning: $5.7x \div 5.7 = 17.1 \div 5.7$

3. $\frac{1}{10}x = \frac{2}{5}$

$x = 4$

Sample reasoning: I divided both sides of the equation by $\frac{1}{10}$.

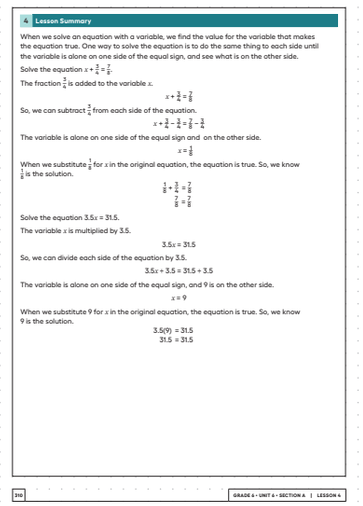
Responding To Student Thinking

Points to Emphasize

If most students struggle with solving equations with one variable, reinforce the connection between diagram representations and the use of algebraic strategies in the next two lessons. For example, ask students to represent each equation with a hanger diagram before solving it algebraically in:

Grade 6, Unit 6, Lesson 5, Activity 2 Choosing Equations to Match Situations

Student Workbook

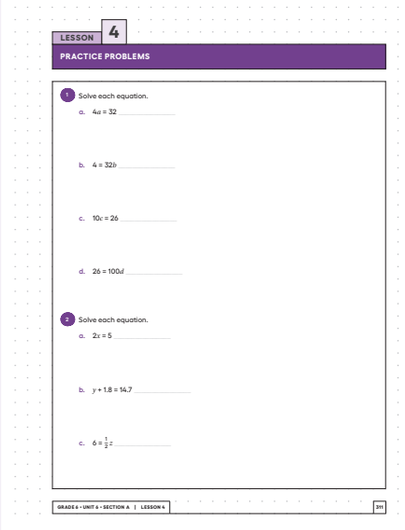


Lesson 4

Practice Problems

5 Problems

Student Workbook


LESSON 4

PRACTICE PROBLEMS

1 Solve each equation.

a. $4a = 32$

b. $4 = 32b$

c. $10c = 26$

d. $26 = 100d$

2 Solve each equation.

a. $2x = 5$

b. $y + 1.8 = 14.7$

c. $6 = \frac{1}{2}z$

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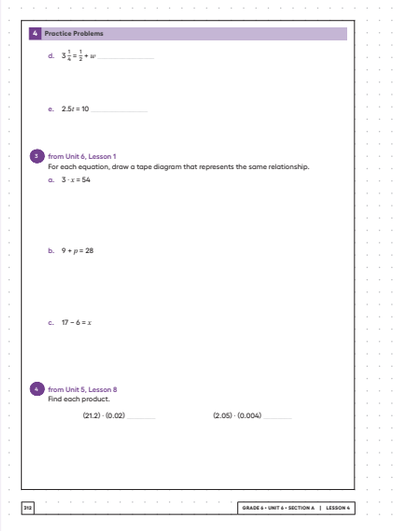
Student Workbook


A Practice Problems

d. $3\frac{1}{4} = \frac{1}{2} + w$

e. $2.5t = 10$

3 from Unit 6, Lesson 1

For each equation, draw a tape diagram that represents the same relationship.

a. $3 \cdot x = 54$

b. $9 + p = 28$

c. $17 - 6 = x$

4 from Unit 5, Lesson 8

Find each product.

$(21.2) \cdot (0.02)$ $(2.05) \cdot (0.004)$

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Problem 1

Solve each equation.

a. $4a = 32$

$a = 8$

b. $4 = 32b$

$b = \frac{1}{8}$ (or equivalent)

c. $10c = 26$

$c = 2.6$ (or equivalent)

d. $26 = 100d$

$d = 0.26$ (or equivalent)

Problem 2

Solve each equation.

a. $2x = 5$

$x = \frac{5}{2}$ (or equivalent)

b. $y + 1.8 = 14.7$

$y = 12.9$

c. $6 = \frac{1}{2}z$

$z = 12$

d. $3\frac{1}{4} = \frac{1}{2} + w$

$w = 2\frac{3}{4}$ (or equivalent)

e. $2.5t = 10$

$t = 4$

Problem 3

from Unit 6, Lesson 1

For each equation, draw a tape diagram that represents the same relationship.

a. $3 \cdot x = 54$

Sample response: Students draw a tape diagram showing 3 groups labeled x and a total of 54.

b. $9 + p = 28$

Sample response: Students draw a tape diagram showing one part labeled 9 and another labeled x and a total of 28.

c. $17 - 6 = x$

Sample response: Students draw a tape diagram showing one part labeled 6 and another labeled x and a total of 17.

Problem 4

from Unit 5, Lesson 8

Find each product.

$(21.2) \cdot (0.02)$ 0.424

$(2.05) \cdot (0.004)$ 0.0082

Problem 5

from Unit 3, Lesson 13

For a science experiment, students need to find 25% of 60 grams.

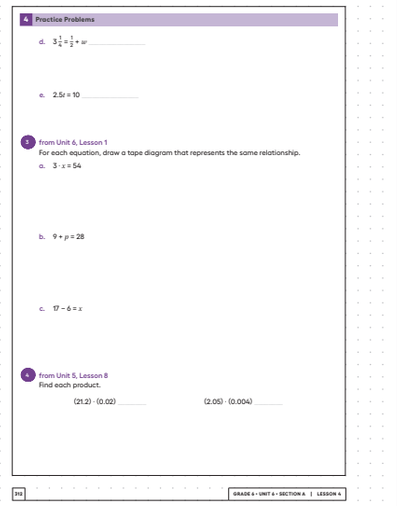
- Jada says, "I can find this by calculating $\frac{1}{4}$ of 60."
- Andre says, "25% of 60 means $\frac{25}{100} \cdot 60$."

Do you agree with either of them? Explain your reasoning.

Both are correct.

Andre is right that 25% of a number means $\frac{25}{100}$ of that number. Jada is also right because $\frac{25}{100} = \frac{1}{4}$.

Student Workbook


4 Practice Problems

d. $3\frac{1}{4} = \frac{1}{2} + w$

e. $2.5r = 10$

3 from Unit 6, Lesson 1
For each equation, draw a tape diagram that represents the same relationship.
a. $3 \cdot x = 54$

b. $9 + p = 28$

c. $17 - 6 = x$

4 from Unit 5, Lesson 8
Find each product.
(21.2) · (0.02) (2.05) · (0.004)

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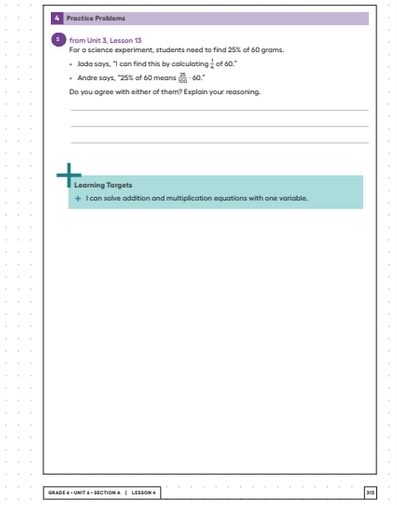
Student Workbook


4 Practice Problems

5 from Unit 3, Lesson 13
For a science experiment, students need to find 25% of 60 grams.
- Jada says, "I can find this by calculating $\frac{1}{4}$ of 60."
- Andre says, "25% of 60 means $\frac{25}{100} \cdot 60$."

Do you agree with either of them? Explain your reasoning.

Learning Targets
+ I can solve addition and multiplication equations with one variable.

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