7.6 Algebra: Solving addition equations

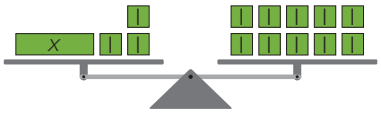
In this lesson, students solve algebraic equations involving addition where the variable is the first addend (for example, 16 = *a* + 12 or *a* + 12 = 16). They use the inverse operation, subtraction, to change both expressions in the same way. This reinforces the known connection between addition and subtraction.

Step 1 Preparing the lesson

Each student will need:

- Student Journal 7.6

Step 2 Starting the lesson



Review the previous lesson to reinforce the students' understanding of the need to change both sides of an equation in the same way to maintain the equivalence. Draw the picture, as shown, on the board and discuss the points below:

What does the pan balance picture tell you about the two groups of tiles?

What equation could you write to match the pan balance picture? (*x* + 3 = 10.)

How can we find out the value of x in this problem?

Encourage discussion among the students. Strategies may include crossing out three square tiles from each side of the pan balance. Ask, *How can we check that our answer is correct?* (**SMP1**)

Step 3 Teaching the lesson

Draw the picture, as shown, on the board. Then discuss the points below:

What can you tell me about this pan balance picture?

What equation could you write to match the picture? (15 = *x* + 5)

How can we find out the value of x in this problem?

Invite a student to cross out single tiles on both sides to determine the value of *x*. Then say, *Let's record what (Evan) just did.* Record the steps on the board as you say, *There were 15 single tiles on the left side and (Evan) crossed out 5. We can write 15 – 5. Then on the right we had x + 5 single tiles and (Evan) crossed out 5. We can write x + 5 – 5 to show this. These two expressions balance so we can write the equation 15 – 5 = x + 5 – 5. Who can solve this equation to find the value of x?* Invite a volunteer to show their thinking on the board.

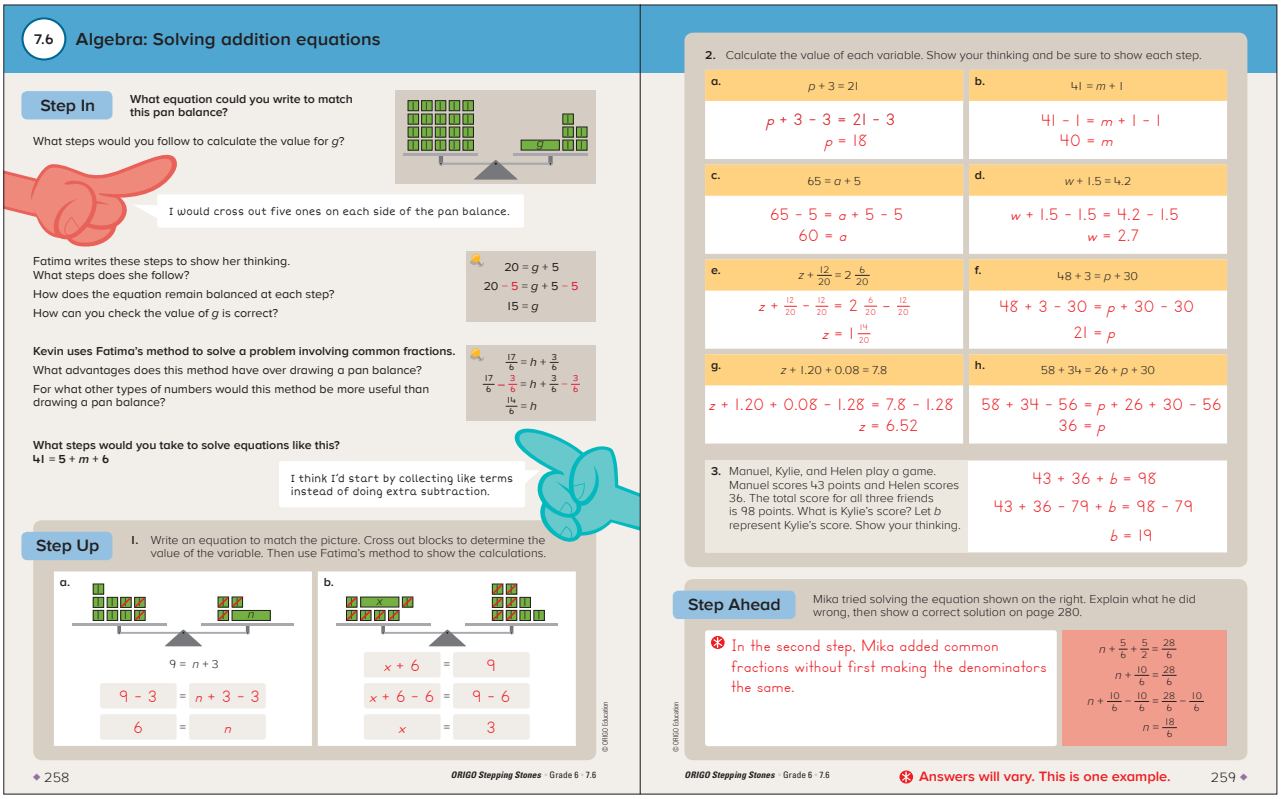
Write the equation $y + 7 = 16$ on the board. Ask:

How can we solve this equation without drawing a picture or using tiles on a pan balance? What steps will you follow? (Subtract 7 from both sides.)

Tell me why you decided to subtract 7 from both sides? (Because subtraction is the inverse operation of addition and it undoes addition.) (**SMP7**)

What equation would you write to show your thinking?

Student Journal 7.6, pp. 258–259



7.6 Algebra: Solving addition equations

Step In What equation could you write to match this pan balance?

What steps would you follow to calculate the value for g?

I would cross out five ones on each side of the pan balance.

Fatima writes these steps to show her thinking.
What steps does she follow?
How does the equation remain balanced at each step?
How can you check the value of g is correct?

$20 = g + 5$
$20 - 5 = g + 5 - 5$
$15 = g$

Kevin uses Fatima's method to solve a problem involving common fractions.
What advantages does this method have over drawing a pan balance?
For what other types of numbers would this method be more useful than drawing a pan balance?

$\frac{17}{6} = h + \frac{3}{6}$
$\frac{17}{6} - \frac{3}{6} = h + \frac{3}{6} - \frac{3}{6}$
$\frac{14}{6} = h$

What steps would you take to solve equations like this?
$41 = 5 + m + 6$

I think I'd start by collecting like terms instead of doing extra subtraction.

Step Up 1. Write an equation to match the picture. Cross out blocks to determine the value of the variable. Then use Fatima's method to show the calculations.

a. $9 = n + 3$
$9 - 3 = n + 3 - 3$
$6 = n$

b. $x + 6 = 9$
$x + 6 - 6 = 9 - 6$
$x = 3$

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2. Calculate the value of each variable. Show your thinking and be sure to show each step.

a. $p + 3 = 21$
$p + 3 - 3 = 21 - 3$
$p = 18$

b. $41 = m + 1$
$41 - 1 = m + 1 - 1$
$40 = m$

c. $65 = a + 5$
$65 - 5 = a + 5 - 5$
$60 = a$

d. $w + 1.5 = 4.2$
$w + 1.5 - 1.5 = 4.2 - 1.5$
$w = 2.7$

e. $z + \frac{12}{20} = 2\frac{6}{20}$
$z + \frac{12}{20} - \frac{12}{20} = 2\frac{6}{20} - \frac{12}{20}$
$z = 1\frac{14}{20}$

f. $48 + 3 = p + 30$
$48 + 3 - 30 = p + 30 - 30$
$21 = p$

g. $z + 1.20 + 0.08 = 7.8$
$z + 1.20 + 0.08 - 1.28 = 7.8 - 1.28$
$z = 6.52$

h. $58 + 34 = 26 + p + 30$
$58 + 34 - 56 = p + 26 + 30 - 56$
$36 = p$

3. Manuel, Kylie, and Helen play a game. Manuel scores 43 points and Helen scores 36. The total score for all three friends is 98 points. What is Kylie's score? Let b represent Kylie's score. Show your thinking.

$43 + 36 + b = 98$
$43 + 36 - 79 + b = 98 - 79$
$b = 19$

Step Ahead Mika tried solving the equation shown on the right. Explain what he did wrong, then show a correct solution on page 280.

In the second step, Mika added common fractions without first making the denominators the same.

$n + \frac{5}{6} + \frac{5}{2} = \frac{28}{6}$
$n + \frac{10}{6} = \frac{28}{6}$
$n + \frac{10}{6} - \frac{10}{6} = \frac{28}{6} - \frac{10}{6}$
$n = \frac{18}{6}$

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Answers will vary. This is one example.

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Invite a volunteer to explain their thinking and to write the equations, as shown, on the board to determine the value of y.

$$y + 7 = 16$$
$$y + 7 - 7 = 16 - 7$$
$$y = 9$$

Ask, *How can we check the answer?* (Substitute the value of y into the original equation to check that the answer is correct.) Repeat the discussion for the equations $19 = m + 8$ and then $p + 6 = 13$.

Work through the Step In discussion (Student Journal 7.6) with the whole class. Read the Step Up and Step Ahead instructions with the students. Make sure they know what to do, then have them work independently to complete the tasks.

Step 4 Reflecting on the work

Discuss the students' answers to Student Journal 7.6. For each of the examples in Question 2, invite students to show their thinking on the board. Discuss any variations in methods. Then organise students into groups of three to discuss their responses to Step Ahead and explain the steps they recorded (**SMP6**). Write the equation $11 + c + 28 = 55$ on the board. Ask, *How would you solve this equation?* Guide the students to see that the most efficient first step is to collect like terms to avoid extra subtraction. Then ask, *What operation do we use to solve addition equations?* (Subtraction.) *Why?* (Because subtraction is the inverse operation of addition and it undoes the addition.) (**SMP7**)

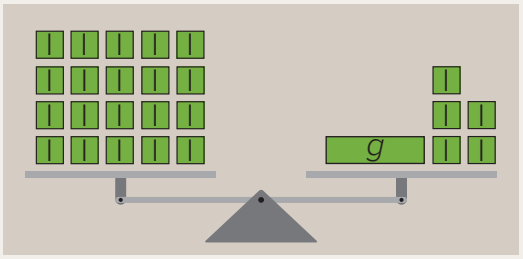
ELL

Pair the students with fluent English-speaking students. Encourage them to think about the questions being asked. Then give them the opportunity to say their answer to the other student before presenting to the class. Provide sentence stems such as, "The method I used was ... because ..."

7.6 Algebra: Solving addition equations

Step In

What equation could you write to match this pan balance?



What steps would you follow to calculate the value for g?

I would cross out five ones on each side of the pan balance.

Fatima writes these steps to show her thinking.
What steps does she follow?

How does the equation remain balanced at each step?

How can you check the value of g is correct?

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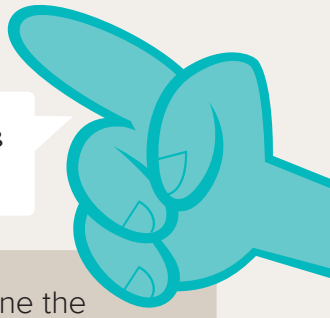
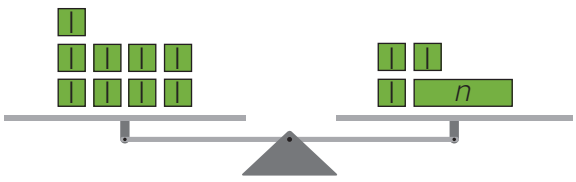


Step Up

1. Write an equation to match the picture. Cross out blocks to determine the value of the variable. Then use Fatima's method to show the calculations.

a.

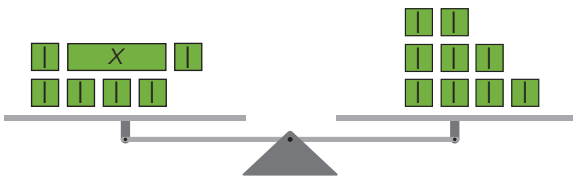


$9 = n + 3$

____ = ____

____ = ____

b.



____ = ____

____ = ____

____ = ____

2. Calculate the value of each variable. Show your thinking and be sure to show each step.

a. $p + 3 = 21$

$p + 3 - 3 = 21 - 3$

b. $41 = m + 1$

c. $65 = a + 5$

d. $w + 1.5 = 4.2$

e. $z + \frac{12}{20} = 2\frac{6}{20}$

f. $48 + 3 = p + 30$

g. $z + 1.20 + 0.08 = 7.8$

h. $58 + 34 = 26 + p + 30$

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Step Ahead

Mika tried solving the equation shown on the right. Explain what he did wrong, then show a correct solution on page 280.

$$n + \frac{5}{6} + \frac{5}{2} = \frac{28}{6}$$

$$n + \frac{10}{6} = \frac{28}{6}$$

$$n + \frac{10}{6} - \frac{10}{6} = \frac{28}{6} - \frac{10}{6}$$

$$n = \frac{18}{6}$$

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Step In

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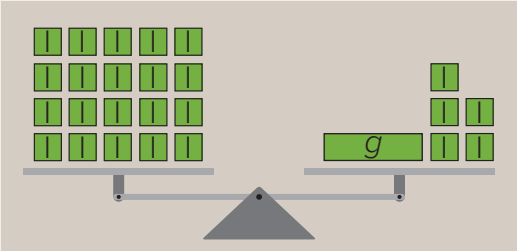

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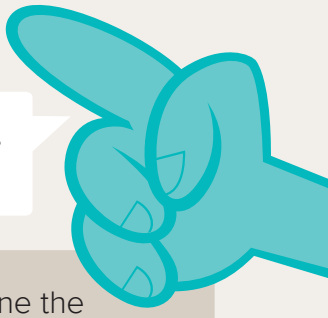

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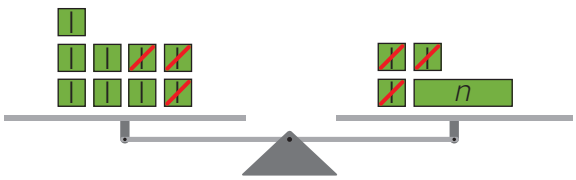

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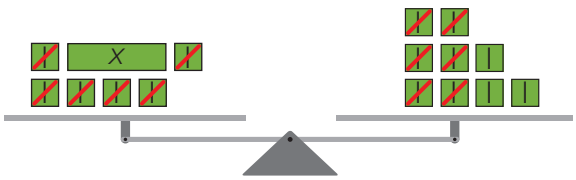
6	=	n

b.



$x + 6$	=	9
$x + 6 - 6$	=	$9 - 6$
x	=	3

2. Calculate the value of each variable. Show your thinking and be sure to show each step.

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Step Ahead

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$n = \frac{18}{6}$

In the second step, Mika added common fractions without first making the denominators the same.

Answers will vary. This is one example.

Computation Practice

★ Complete the equations. Then write each letter above its matching answer at the bottom of the page to discover a science fact. Some letters are used more than once.

$\frac{1}{4}$ of 240 = ☐ **v**	$\frac{1}{5}$ of 160 = ☐ **i**	$\frac{1}{10}$ of 720 = ☐ **f**
$\frac{1}{4}$ of 440 = ☐ **a**	$\frac{1}{5}$ of 270 = ☐ **b**	$\frac{1}{10}$ of 260 = ☐ **u**
$\frac{1}{4}$ of 320 = ☐ **t**	$\frac{1}{5}$ of 340 = ☐ **h**	$\frac{1}{10}$ of 560 = ☐ **s**
$\frac{1}{4}$ of 180 = ☐ **y**	$\frac{1}{5}$ of 420 = ☐ **d**	$\frac{1}{10}$ of 640 = ☐ **q**
$\frac{1}{4}$ of 340 = ☐ **o**	$\frac{1}{5}$ of 530 = ☐ **c**	$\frac{1}{10}$ of 190 = ☐ **r**
$\frac{1}{4}$ of 360 = ☐ **w**	$\frac{1}{4}$ of 220 = ☐ **e**	

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106 85 60 55 19 55 84 54 45

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90 110 80 55 19

Ongoing Practice

1. Identical products are being sold. Shade the ⬭ beside the better offer. Show your thinking.

FROM 6.6.12

a. ⬭ 6 muffins for $9 ⬭ 4 muffins $5

b. ⬭ 8 tickets for $320 ⬭ 6 tickets for $270

c. ⬭ 4 cards for $8 ⬭ 8 cards for $12

d. ⬭ 5 kg for $15 ⬭ 3 kg for $12

2. Write each expression so that like terms are grouped together.

FROM 6.7.4

a. $4d + 2 + 2d + 5e =$ ____

b. $20x + 20x^2 + x =$ ____

c. $15f + f + f + f + 5 + 2g =$ ____

d. $4p + p + 4 + 21m^2 =$ ____

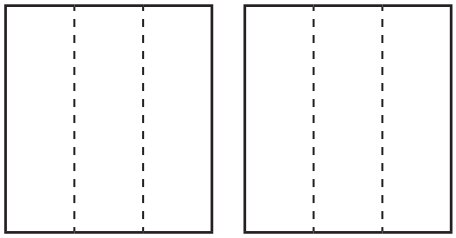
e. $b + b + b + 3c + 2c + 5 =$ ____

f. $v + 5v^2 + v + 2v =$ ____

Preparing for Module 8

Each large rectangle below is one whole. Complete the sentence and color the diagram to show each share.

a. $\frac{2}{3}$ is equivalent to ____ divided by ____



b. $\frac{3}{7}$ is equivalent to ____ divided by ____