



## Lesson 27: One-Step Equations—Multiplication and Division

### Student Outcomes

- Students solve one-step equations by relating an equation to a diagram.
- Students check to determine if their solution makes the equation true.

### Lesson Notes

This lesson teaches students to solve one-step equations using tape diagrams. Through the construction of tape diagrams, students will create algebraic equations and solve for one variable. This lesson not only allows students to continue studying the properties of operations and identity, but also allows students to develop intuition of the properties of equality. This lesson continues the informal study of the properties of equality students have practiced since Grade 1, and also serves as a springboard to the formal study, use, and application of the properties of equality seen in Grade 7. Understand that, while students will intuitively use the properties of equality, diagrams are the focus of this lesson. This lesson purposefully omits focusing on the actual properties of equality, which will be covered in Grade 7. Students will relate an equation directly to diagrams and verbalize what they do with diagrams to construct and solve algebraic equations.

Poster paper is needed for this lesson. Posters need to be prepared ahead of time, one set of questions per poster.

### Classwork

#### Example 1 (5 minutes)

**Example 1**

Solve  $3z = 9$  using tape diagrams and algebraically. Then, check your answer.

First, draw two tape diagrams, one to represent each side of the equation.

9		
$z$	$z$	$z$

If 9 had to be split into three groups, how big would each group be?

3

Demonstrate the value of  $z$  using tape diagrams.

$z$	3	3
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How can we demonstrate this algebraically?

*We know we have to split 9 into three equal groups, so we have to divide by 3 to show this algebraically.*

$$3z \div 3 = 9 \div 3$$

How does this get us the value of  $z$ ?

*The left side of the equation will equal  $z$  because we know the identity property, where  $a \cdot b \div b = a$ , so we can use this identity here.*

*The right side of the equation will be 3 because  $9 \div 3 = 3$ .*

*Therefore, the value of  $z$  is 3.*

How can we check our answer?

*We can substitute the value of  $z$  into the original equation to see if the number sentence is true.*

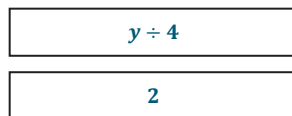
$3(3) = 9; 9 = 9$ . *This number sentence is true, so our answer is correct.*

**Example 2 (5 minutes)**

Example 2

Solve  $\frac{y}{4} = 2$  using tape diagrams and algebraically. Then, check your answer.

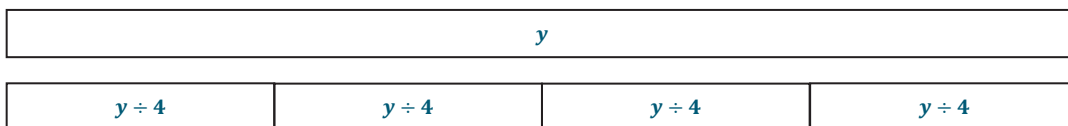
First, draw two tape diagrams, one to represent each side of the equation.



If the first tape diagram shows the size of  $y \div 4$ , how can we draw a tape diagram to represent  $y$ ?

*The tape diagram to represent  $y$  should be four sections of the size  $y \div 4$ .*

Draw this tape diagram.

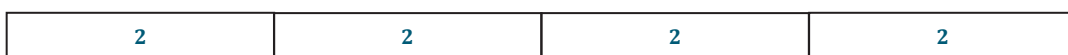


What value does each  $y \div 4$  section represent? How do you know?

*Each  $y \div 4$  section represents a value of 2. We know this from our original tape diagram.*

How can you use a tape diagram to show the value of  $y$ ?

*Draw four equal sections of 2, which will give  $y$  the value of 8.*



How can we demonstrate this algebraically?

$\frac{y}{4} \cdot 4 = 2 \cdot 4$ . Because we multiplied the number of sections in the original equation by 4, we know the identity  $\frac{a}{b} \cdot b = a$  can be used here.

How does this help us find the value of  $y$ ?

The left side of the equation will equal  $y$ , and the right side will equal 8. Therefore, the value of  $y$  is 8.

How can we check our answer?

Substitute 8 into the equation for  $y$ , and then check to see if the number sentence is true.

$\frac{8}{4} = 2$ . This is a true number sentence, so 8 is the correct answer.

### Exploratory Challenge (15 minutes)

Each group (two or three) of students receives one set of problems. Have students solve both problems on poster paper with tape diagrams and algebraically. Students should also check their answers on the poster paper. More than one group may have each set of problems.

*Scaffolding:*

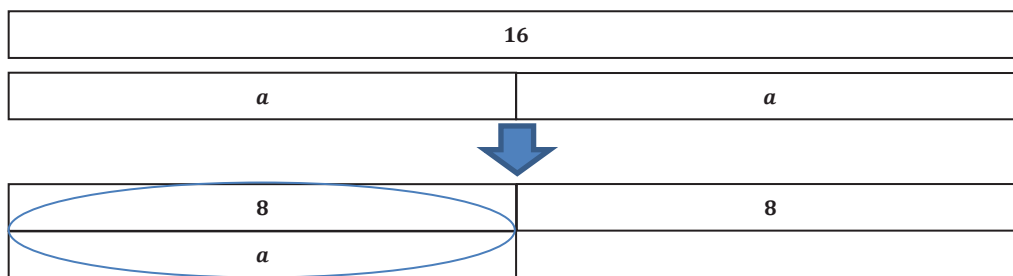
If students are struggling, model one set of problems before continuing with the Exploratory Challenge.

#### Set 1

On poster paper, solve each problem below algebraically and using tape diagrams. Check each answer to show that you solved the equation correctly (algebraic and tape diagram sample responses are below).

1.  $2a = 16$

*Tape Diagrams:*



MP.1

*Algebraically:*

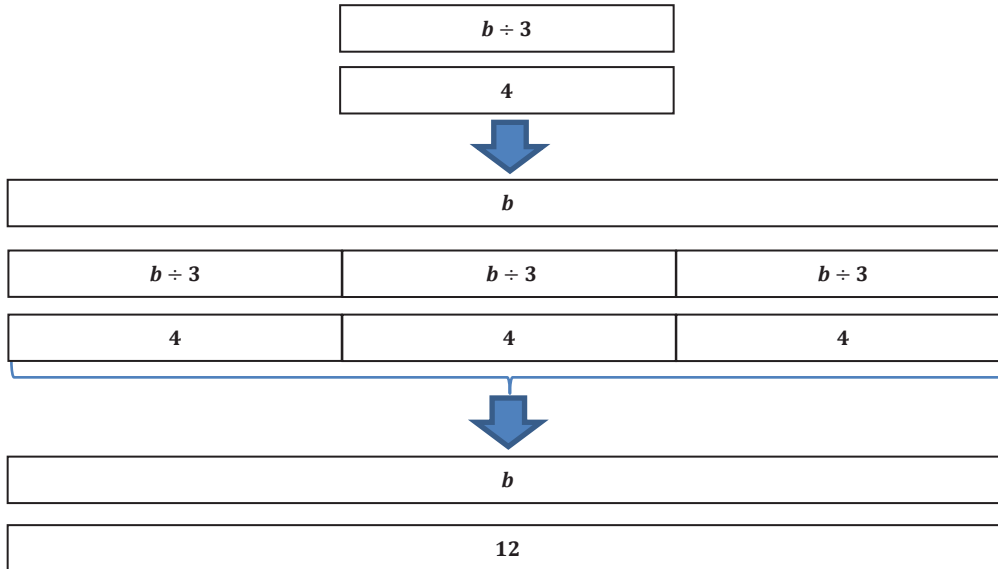
$$\begin{aligned} 2a &= 16 \\ 2a \div 2 &= 16 \div 2 \\ a &= 8 \end{aligned}$$

*Check:*

$2 \cdot 8 = 16$ ;  $16 = 16$ . This is a true number sentence, so 8 is the correct solution.

2.  $\frac{b}{3} = 4$

Tape Diagrams:



Algebraically:

$$\begin{aligned} \frac{b}{3} &= 4 \\ \frac{b}{3} \cdot 3 &= 4 \cdot 3 \\ b &= 12 \end{aligned}$$

Check:  $\frac{12}{3} = 4$ ;  $4 = 4$ . This number sentence is true, so 12 is the correct solution.

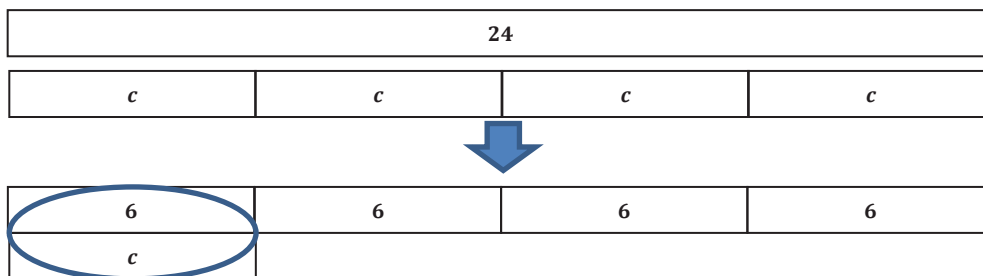
MP.1

Set 2

On poster paper, solve each problem below algebraically and using tape diagrams. Check each answer to show that you solved the equation correctly (algebraic and tape diagram sample responses are below).

1.  $4 \cdot c = 24$

Tape Diagrams:



Algebraically:

$$4 \cdot c = 24$$

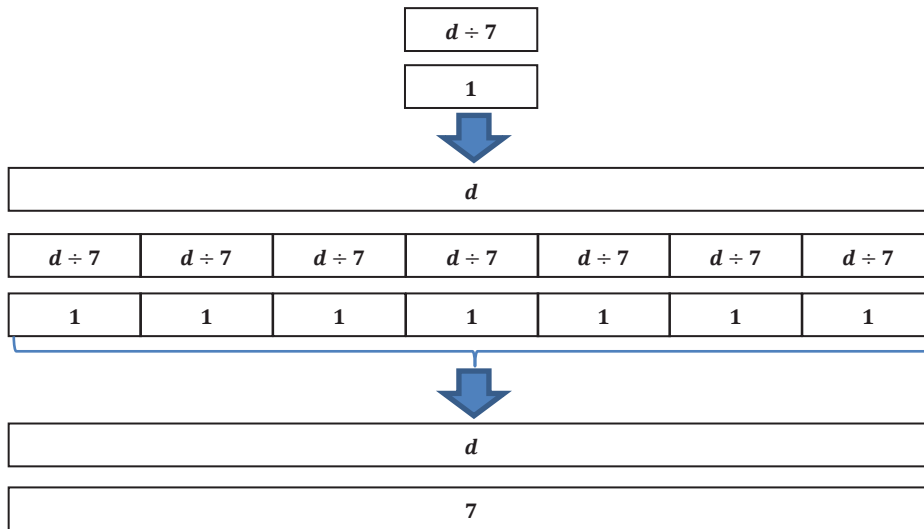
$$4 \cdot c \div 4 = 24 \div 4$$

$$c = 6$$

Check:  $4 \cdot 6 = 24$ ;  $24 = 24$ . This number sentence is true, so 6 is the correct solution.

2.  $\frac{d}{7} = 1$

Tape Diagrams:



MP.1

Algebraically:

$$\frac{d}{7} = 1$$

$$\frac{d}{7} \cdot 7 = 1 \cdot 7$$

$$d = 7$$

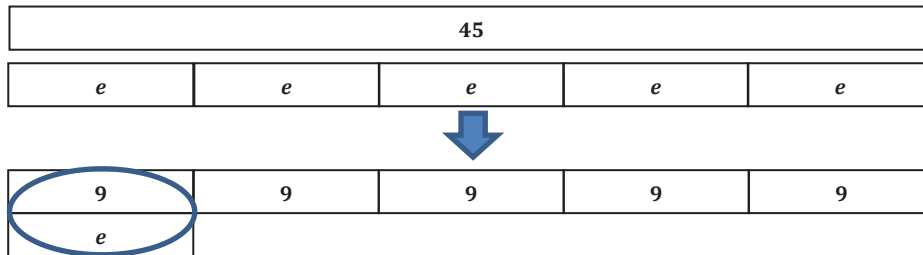
Check:  $\frac{7}{7} = 1$ ;  $1 = 1$ . This number sentence is true, so 7 is the correct solution.

**Set 3**

On poster paper, solve each problem below algebraically and using tape diagrams. Check each answer to show that you solved the equation correctly (algebraic and tape diagram sample responses are below).

1.  $5e = 45$

Tape Diagrams:



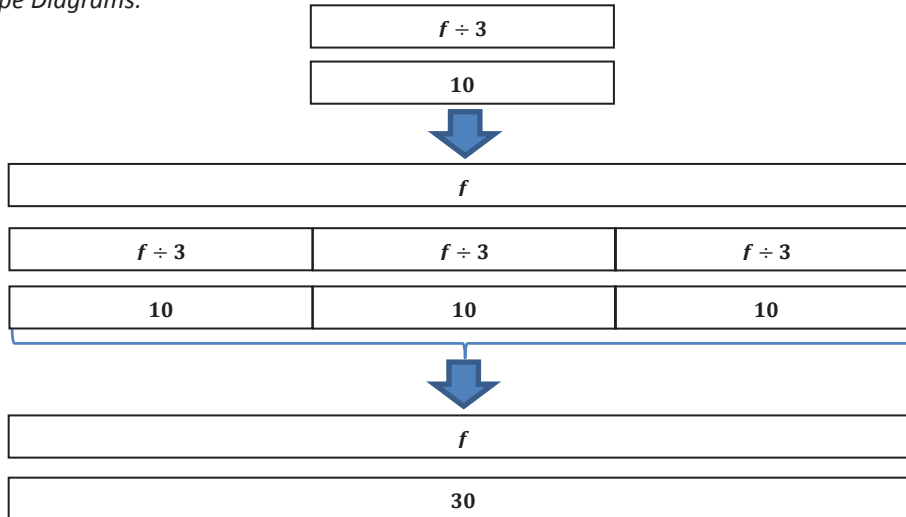
Algebraically:

$$\begin{aligned} 5e &= 45 \\ 5e \div 5 &= 45 \div 5 \\ e &= 9 \end{aligned}$$

Check:  $5(9) = 45$ ;  $45 = 45$ . This number sentence is true, so 9 is the correct solution.

2.  $\frac{f}{3} = 10$

Tape Diagrams:



Algebraically:

$$\begin{aligned} \frac{f}{3} &= 10 \\ \frac{f}{3} \cdot 3 &= 10 \cdot 3 \\ f &= 30 \end{aligned}$$

Check:  $\frac{30}{3} = 10$ ;  $10 = 10$ . This number sentence is true, so 30 is the correct solution.

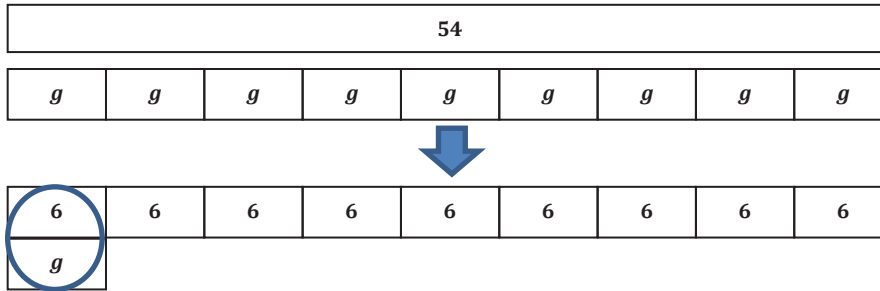
MP.1

**Set 4**

On poster paper, solve each problem below algebraically and using tape diagrams. Check each answer to show that you solved the equation correctly (algebraic and tape diagram sample responses are below).

1.  $9 \cdot g = 54$

Tape Diagrams:



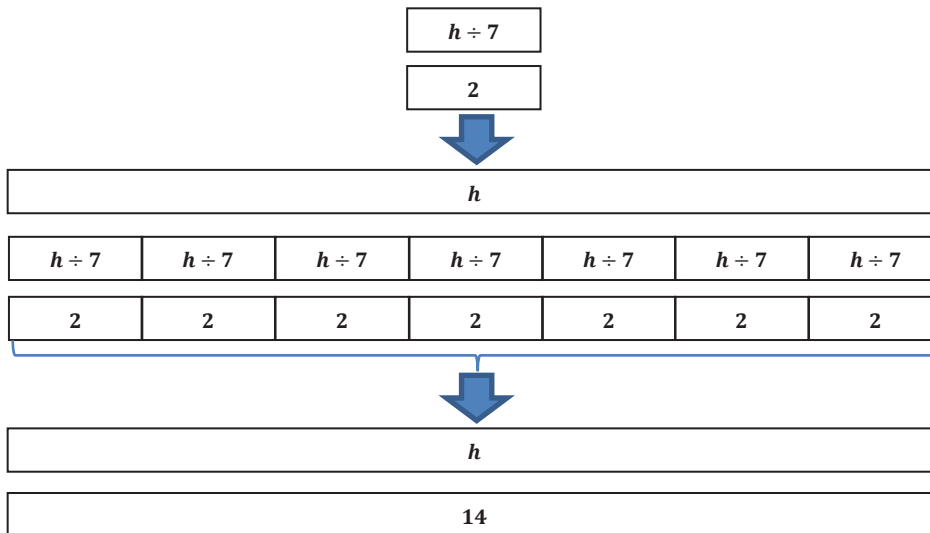
Algebraically:

$$\begin{aligned}
 9 \cdot g &= 54 \\
 9 \cdot g \div 9 &= 54 \div 9 \\
 g &= 6
 \end{aligned}$$

**MP.1** Check:  $9 \cdot 6 = 54$ ;  $54 = 54$ . This number sentence is true, so 6 is the correct solution.

2.  $2 = \frac{h}{7}$

Tape Diagrams:



Algebraically:

$$2 = \frac{h}{7}$$

$$2 \cdot 7 = \frac{h}{7} \cdot 7$$

$$14 = h$$

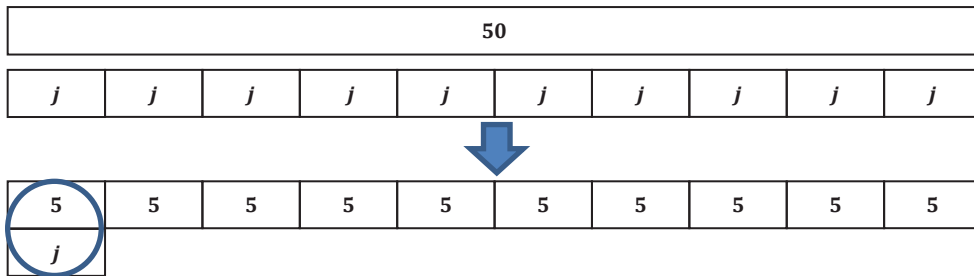
Check:  $2 = \frac{14}{7}$ ;  $2 = 2$ . This number sentence is true, so 14 is the correct solution.

**Set 5**

On poster paper, solve each problem below algebraically and using tape diagrams. Check each answer to show that you solved the equation correctly (algebraic and tape diagram sample responses are below).

1.  $50 = 10j$

**MP.1** Tape Diagrams:



Algebraically:

$$50 = 10j$$

$$50 \div 10 = 10j \div 10$$

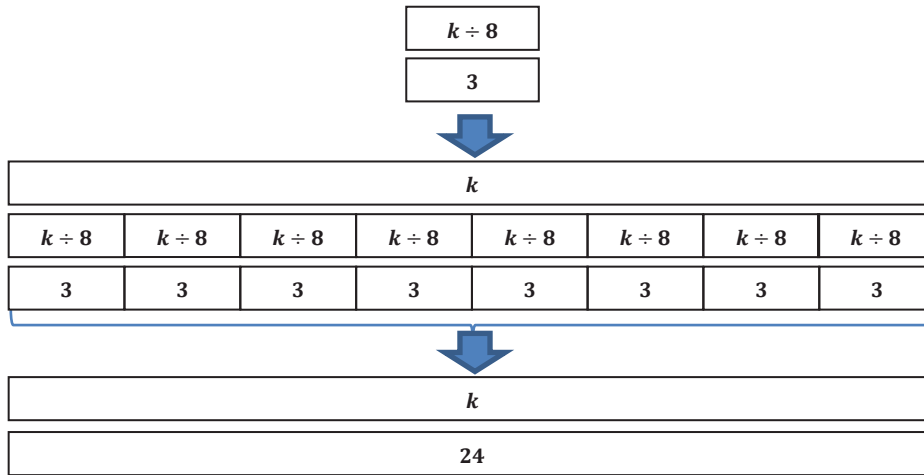
$$5 = j$$

Check:  $50 = 10(5)$ ;  $50 = 50$ . This number sentence is true, so 5 is the correct solution.



2.  $\frac{k}{8} = 3$

Tape Diagrams:



MP.1

Algebraically:

$$\begin{aligned} \frac{k}{8} &= 3 \\ \frac{k}{8} \cdot 8 &= 3 \cdot 8 \\ k &= 24 \end{aligned}$$

Check:  $\frac{24}{8} = 3$ ;  $3 = 3$ . This number sentence is true, so 24 is the correct solution.

MP.3

Hang completed posters around the room. Students walk around to examine other groups' posters. Students may either write on a piece of paper, write on Post-it notes, or write on the posters any questions or comments they may have. Answer students' questions after providing time for students to examine posters.

**Exercises (10 minutes)**

Students complete the following problems individually. Remind students to check their solutions.

**Exercises**

1. Use tape diagrams to solve the following problem:  $3m = 21$ .

21		
$m$	$m$	$m$

↓

7	7	7
$m$		

*Check:  $3(7) = 21$ ;  $21 = 21$ . This number sentence is true, so 7 is the correct solution.*

2. Solve the following problem algebraically:  $15 = \frac{n}{5}$ .

$$15 = \frac{n}{5}$$

$$15 \cdot 5 = \frac{n}{5} \cdot 5$$

$$75 = n$$

*Check:  $15 = \frac{75}{5}$ ;  $15 = 15$ . This number sentence is true, so 75 is the correct solution.*

3. Calculate the solution of the equation using the method of your choice:  $4p = 36$ .

*Tape Diagrams:*

36			
$p$	$p$	$p$	$p$

↓

9	9	9	9
$p$			

*Algebraically:*

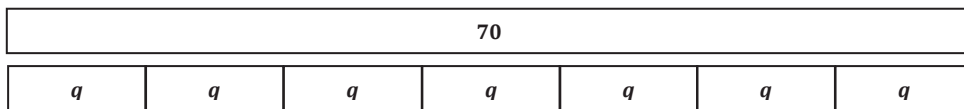
$$4p = 36$$

$$4p \div 4 = 36 \div 4$$

$$p = 9$$

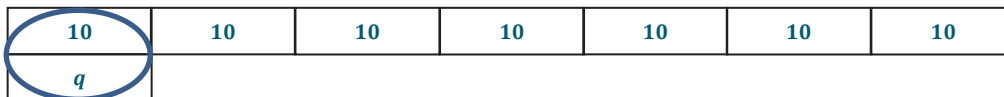
*Check:  $4(9) = 36$ ;  $36 = 36$ . This number sentence is true, so 9 is the correct solution.*

4. Examine the tape diagram below, and write an equation it represents. Then, calculate the solution to the equation using the method of your choice.



$7q = 70$  or  $70 = 7q$

*Tape Diagram:*



*Algebraically:*

$7q = 70$	$70 = 7q$
$7q \div 7 = 70 \div 7$	$70 \div 7 = 7q \div 7$
$q = 10$	$q = 10$

*Check:  $7(10) = 70$ ,  $70 = 7(10)$ ;  $70 = 70$ . This number sentence is true, so 10 is the correct answer.*

5. Write a multiplication equation that has a solution of 12. Use tape diagrams to prove that your equation has a solution of 12.

*Answers will vary.*

6. Write a division equation that has a solution of 12. Prove that your equation has a solution of 12 using algebraic methods.

*Answers will vary.*

**Closing (5 minutes)**

- How is solving addition and subtraction equations similar and different to solving multiplication and division equations?
  - *Solving addition and subtraction equations is similar to solving multiplication and division equations because identities are used for all of these equations.*
  - *Solving addition and subtraction equations is different from solving multiplication and division equations because they require different identities.*
- What do you know about the pattern in the operations you used to solve the equations today?
  - *We used inverse operations to solve the equations today. Division was used to solve multiplication equations, and multiplication was used to solve division equations.*

**Exit Ticket (5 minutes)**



Name \_\_\_\_\_

Date \_\_\_\_\_

## Lesson 27: One-Step Equations—Multiplication and Division

### Exit Ticket

Calculate the solution to each equation below using the indicated method. Remember to check your answers.

1. Use tape diagrams to find the solution of  $\frac{r}{10} = 4$ .

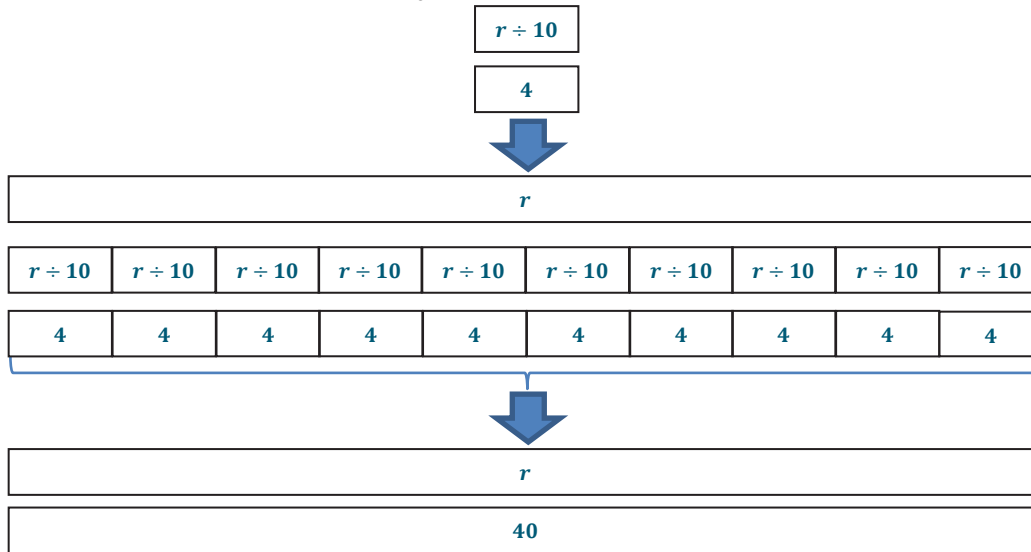
2. Find the solution of  $64 = 16u$  algebraically.

3. Use the method of your choice to find the solution of  $12 = 3v$ .

Exit Ticket Sample Solutions

Calculate the solution to each equation below using the indicated method. Remember to check your answers.

1. Use tape diagrams to find the solution of  $\frac{r}{10} = 4$ .



Check:  $\frac{40}{10} = 4$ ;  $4 = 4$ . This number sentence is true, so 40 is the correct solution.

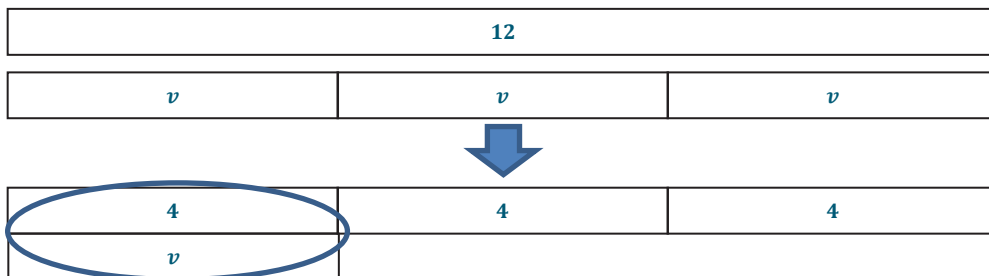
2. Find the solution of  $64 = 16u$  algebraically.

$$\begin{aligned} 64 &= 16u \\ 64 \div 16 &= 16u \div 16 \\ 4 &= u \end{aligned}$$

Check:  $64 = 16(4)$ ;  $64 = 64$ . This number sentence is true, so 4 is the correct solution.

3. Use the method of your choice to find the solution of  $12 = 3v$ .

Tape Diagrams:



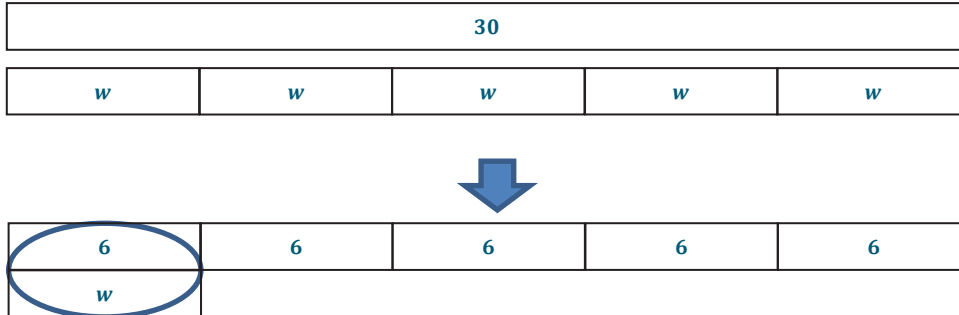
Algebraically:

$$\begin{aligned} 12 &= 3v \\ 12 \div 3 &= 3v \div 3 \\ 4 &= v \end{aligned}$$

Check:  $12 = 3(4)$ ;  $12 = 12$ . This number sentence is true, so 4 is the correct solution.

Problem Set Sample Solutions

1. Use tape diagrams to calculate the solution of  $30 = 5w$ . Then, check your answer.



Check:  $30 = 5(6)$ ;  $30 = 30$ . This number sentence is true, so 6 is the correct solution.

2. Solve  $12 = \frac{x}{4}$  algebraically. Then, check your answer.

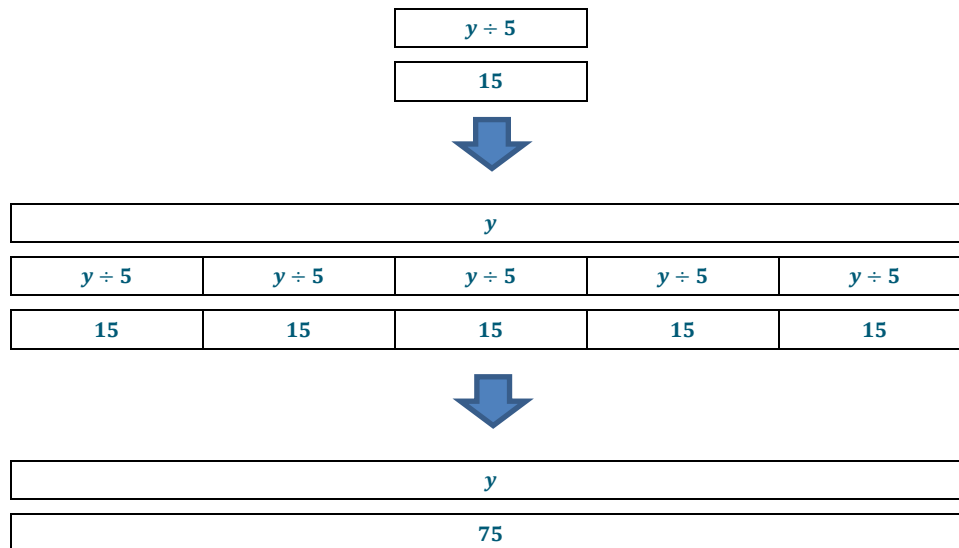
$$12 = \frac{x}{4}$$

$$12 \cdot 4 = \frac{x}{4} \cdot 4$$

$$48 = x$$

Check:  $12 = \frac{48}{4}$ ;  $12 = 12$ . This number sentence is true, so 48 is the correct solution.

3. Use tape diagrams to calculate the solution of  $\frac{y}{5} = 15$ . Then, check your answer.



Check:  $\frac{75}{5} = 15$ ;  $15 = 15$ . This number sentence is true, so 75 is the correct solution.

4. Solve  $18z = 72$  algebraically. Then, check your answer.

$$\begin{aligned} 18z &= 72 \\ 18z \div 18 &= 72 \div 18 \\ z &= 4 \end{aligned}$$

*Check:*  $18(4) = 72$ ;  $72 = 72$ . This number sentence is true, so 4 is the correct solution.

5. Write a division equation that has a solution of 8. Prove that your solution is correct by using tape diagrams.

*Answers will vary.*

6. Write a multiplication equation that has a solution of 8. Solve the equation algebraically to prove that your solution is correct.

*Answers will vary.*

7. When solving equations algebraically, Meghan and Meredith each got a different solution. Who is correct? Why did the other person not get the correct answer?

Meghan	Meredith
$\frac{y}{2} = 4$	$\frac{y}{2} = 4$
$\frac{y}{2} \cdot 2 = 4 \cdot 2$	$\frac{y}{2} \div 2 = 4 \div 2$
$y = 8$	$y = 2$

*Meghan is correct. Meredith divided by 2 to solve the equation, which is not correct because she would end up with  $\frac{y}{4} = 2$ . To solve a division equation, Meredith must multiply by 2 to end up with  $y$  because the identity states  $y \div 2 \cdot 2 = y$ .*